DOCUMENT RESUME

ED 393 741 SO 025 847

TITLE	The Better Idea Book: A Resource Book on Gender, Culture, Science, and Schools.
INSTITUTION	Canadian Teachers' Federation, Ottawa (Ontario).; Ontario Women's Directorate, Ottawa.
REPORT NO	ISBN-0-88989-262-8
PUB DATE	Nov 92
NOTE	157p.; Issued in French under the title "LeCahier d'idees Ameliore: Liens entre la categorie de sexe, la culture, les sciences et les ecoles" (ISBN-0-88989-263-6).
AVAILABLE FROM	Canadian Teachers' Federation, 110 Argyle Ave., Ottawa, Ontario K2P 1B4 Canada.
PUB TYPE	Guides - Non-Classroom Use (055) -- Reference Materials - Bibliographies (131)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Annotated Bibliographies; Canadian Studies; *Culture; Educational Research; Females; Foreign Countries; Higher Education; Mathematics; *Public Schools; *Sciences; Secondary Education; Technology; *Womens Education
IDENTIFIERS	*Canada; *Gender Issues; Girls into Science and Technology Project; Math Science Technology Education Project

ABSTRACT

"The Idea Book" was first published in 1988 by the Canadian Teachers Federation and examined females in the mathematics, science, and technology fields. "The Better Idea Book" is a re-publication that includes new studies and other resources that relate to the increased numbers of females in technological fields. The first section examines the increased importance of science and technology based on recent events and trends and discusses how schools have retooled to produce more highly skilled workers. "Gendered Science; Gendered Schools" examines whether biological makeup has anything to do with male and female representation in the field of science. The quality of girls' lives is covered in chapter 4, which summarizes three Canadian and one American study on adolescents. Chapter 5 probes testing and examines biases, jurisdictional comparisons, and biological data. In chapter 6. data from studies of the impact of the study of mathematics, science, and technology after secondary education are analyzed. Teachers are the focus of chapter 7, which looks at who is involved in mathematics, science, and technology programs. Conclusions show that improvement has been made in Canada in the participation rate of girls in mathematics, science, and technology but that further studies need to be done in order to assure that the success rate continues. A 71-item listing of end notes and a 72-page annotated bibliography conclude the text. (JAG)

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A Resource Book on Gender, Culture, Science and Schools

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The publication of The BETTER Idea Book is a product of the cooperation between the Ontario Women's Directorate and the Canadian Teachers' Federation. While the text has been developed by CTF, the annotated bibliography is an up-to-date version of Background Materials and Curriculum Resources to Encourage Females Into Mathematics, Science and Technology: An Annotated Bibliography, prepared by Beth McAuley, published by the Ontario Women's Directorate in March 1990. Together they create more than either standing alone.

Many thanks to Ann Holmes, of the Ontario Women's Directorate for her enthusiasm and commitment; to Rose Costanzo, who collected much of the provincial/territorial data, and to the many staff members of CTF who worked on every part of this publication.

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November 1992

November 1992

The BETTER Idea Book: A Resource on Gender, Culture, Science and Schools

Issued also in French under title: Le Cahier d'idées AMÉLIORÉ : Liens entre la catégorie de sexe, la culture, les sciences et les écoles

ISBN 0-88989-262-8 (English version)
ISBN 0-88989-263-6 (French version)

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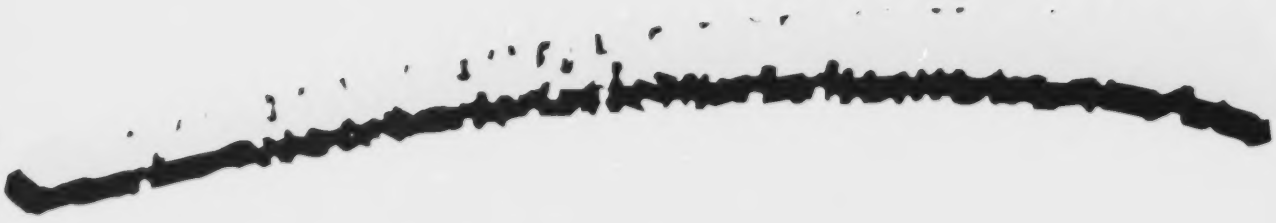
THE IDEA BOOK



A RESOURCE BOOK ON GENDER, CULTURE, SCIENCE AND SCHOOLS

The Better Idea Book

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Introduction

Introduction

Beyond Remediation

When the Idea Book was published by the Canadian Teachers' Federation in 1988, the prevailing ways of thinking about females with respect to **M**athematics, **S**cience and **T**echnology seemed to have plateaued.[1] With the exception of a few critical observers, girls and MST (an increasingly useful abbreviation) had been examined from a remedial perspective. Girls were labelled by inference, if not by word, as collectively deficient for not recognizing the importance of MST, and for lacking the confidence necessary to persevere and succeed. Teachers and their school systems were seen as requiring professional remediation in order to correct their negative impact on girls who aspired to MST achievement. The lack of role models depicting successful women following non-traditional careers was lamented. Efforts to remediate girls, teachers and perceptions of reality were pursued enthusiastically, but often as if these indices were independent variables existing outside the forces of history and culture. While it would be overly optimistic to suggest this facile diagnose-and-remediate approach has disappeared, the nature of the discussion has changed, and new complexities have emerged.

A resurgence of interest in girls and women's participation and success in MST has stimulated research, political rhetoric, anxiety, innovation, individual triumphs and a variety of unchallenged assumptions. The literature has expanded almost exponentially. In preparing the original Idea Book, a review of the available data and key strategies was not difficult to compile. Only a few dozen Canadian projects devoted to girls and MST were identified; at that time it was possible to initiate an informal national network of committed individuals. The re-publication of The BETTER Idea Book, which includes an annotated bibliography first published by the Ontario Women's Directorate[2], illustrates the growth of research, commentary and interest in the topics the original Idea Book addressed. Characteristic of most of the recent popular and scholarly contributions to this discussion is an understanding that "remediation" as a goal is a flawed and self-defeating objective, that "science" is a gendered concept, and that neither girls' lives nor MST can be considered independent of related trends, ideologies or events.

The purpose of the first section of The BETTER Idea Book is to identify and comment upon the key ideas which are shaping our national interest in girls and MST, to discuss the extent to which this interest fits into other agenda, and to establish the necessity of dealing with MST issues within a broad context which recognizes women's experience. The section titled "Gendered Science; Gendered Schools" provides an introduction to critiques of the study of MST against a backdrop of other aspects of the issue of gender in the classroom. Recognizing the necessity of rooting MST initiatives in accordance with the realities of girls' lives, section four summarizes three Canadian and one American study on adolescents, and considers their implications for teaching young women. Section five examines the limitations of tests as indicators of "success" and

presents an overview of concerns about gender-bias in testing. Jurisdictional results are discussed and the question, "is MST success biological?" is explored. Section six returns to the placement of the "economic imperative" argument in MST-and-gender initiatives, and considers the impact of the study of MST at the post-secondary level. The reality of being part of a male-dominated profession is presented from several points of view. Section seven begins the discussion which must be undertaken by the teaching profession and other educators. The text offers more questions than it answers, which perhaps befits the multi-layered conversation it is intended to provoke. Section eight summarizes the most important conclusions of the paper, and provides some advice to those who want to make a difference.

The Ascendency of MST

The Ascendency of MST

Trends, Events and Connections

2.1 Retooling Schools

Phrases once limited to the hyperbole of elite boardrooms have become slogans of our times. As a nation, we have been exhorted so relentlessly to become competitive that few citizens can be unaware of the claim that the Canadian workforce must become more competitive if we are to maintain the quality of life we enjoy or to which we aspire.

Perhaps to the surprise of educators accustomed to the relative political isolation of elementary and secondary education, this enthusiasm for the efficient training of competitive and value-added workers has sparked critical attention directed to schools.

Much of the organized debate has been national in scope. Publications such as Learning Well, Living Well[1] from the Prosperity Secretariat, and A Lot to Learn[2] from the Economic Council of Canada are seen as bold, not so much because of their content, but because of their symbolic trespass into the educational jurisdiction of the provinces and territories. Programs such as the Federal Government's "Stay-in-School" initiative test the waters regarding a more active Federal role. The Economic Council of Canada, in its last published report, concludes that by and large the performance of Canadian schools is dismal. Individual writers find editors eager to publish critical commentary of schools whether or not it is well informed. A substantial part of this criticism rests on the apparent failure of Canadian students to outscore their international counterparts on MST subjects, and on our schools' failure to produce enough readily-employable, highly-skilled workers.

A brief analysis of the questionable data used to support these conclusions appears later in this paper, but quite aside from the issue of validity is the fact that elementary and secondary schools have not been established to act as pre-employment training centers for knowledge-centric occupations. Job training has never been a central purpose of elementary and secondary schools; to reformulate them for this purpose may be advisable in the eyes of some, but debating the multiple goals of education surely should precede this conclusion. However, to assume this trend towards narrowing definitions of schooling will diminish is to ignore the extent of anxiety and the sense of urgency which pervades public analysis of problems and solutions. Anxiety does not often beget reason.

Now that the trends towards "competitiveness" and "retooling schools" have been joined by the politicization of the measurement of educational achievement, the ascendency of MST in the curriculum for better or worse, would appear to be guaranteed. Inevitably, the bulk of the time and money to be spent on standardized examinations in Canada will be devoted to measuring achievement in the least subjective curriculum areas. Those subjects best-suited to single-right-answer responses are far less expensive to test, and more compatible with computer score sheets than valid measures of interpersonal skills, creativity or self-esteem. The pressure on schools to improve performance on those subjects most often compared inter-provincially, nationally or even locally will persist independently of any philosophy expressed by curriculum guidelines. Teacher and student time will be re-deployed to emphasize the subjects to be tested; what is less measurable will recede in the attention of policy-makers and the classroom. Thus curriculum will follow political priorities and, for the foreseeable future, these priorities will be restricted almost exclusively to reforms alleged to enhance competitiveness and accommodate political interests.

The potential for exploiting the "competitiveness" argument to advance the agenda for girls and MST has been recognized and sometime embraced with enthusiasm. Girls engaged in gender-traditional fields are often depicted as an "untapped resource", a pool of talent requiring only encouragement to double Canada's indigenous capacity to produce the most desirable kind of worker. For example, the report of the Canadian Committee on Women and Engineering[3] asserts:

> *"The economic well-being of Canada and the development of its technological base depends to a great extent on the effective employment of engineers. In this period of global competition and rapid technological developments, employers cannot be satisfied with anything less than the very best engineers available, regardless of their gender."*

When the provincial/territorial Ministers of Education and the federal and provincial/territorial Ministers Responsible for the Status of Women met in 1990, their documentation focused almost exclusively on women's labour force participation and preparation rather than on any moral or ethical principles asserting the right of individual women to develop and enjoy their talents free of barriers based on their gender.[4] When "women-and-MST" is discussed, the safer ground of economics seems to be preferred to the contentious debate over power and exclusion based on gender.

While the strategy of using economic-imperative arguments in the interest of girls and women is unquestionably tempting, it is worth remembering that pragmatism has its own pitfalls. If one argues only that it is good for the economy for more women to become scientists, on what basis does one refute the statement that pay equity should be denied if it is said to be bad for the economy? Are the only

advances in human rights to be those proven to benefit the political or corporate bottom line? This is surely pragmatism devoid of morality. Educators must continue to remind the public that what we want our students to achieve is far more complex than either an answer sheet or a balance sheet, and that what is fair is as important as what is expedient. In turbulent times, if educators do not claim this position, we can hardly be surprised if it is not advanced by others.

2.2 Event and Aftermath

On December 6, 1989, fourteen women whose names few remember were murdered by a man whose name will not be forgotten. These were young women who were killed for presuming to act on the rhetoric of gender equality; they were young women who believed they could make room for themselves at the École Polytechnique as students of Engineering. These victims were targeted not only as women but as "feminists", it was not just their gender but their escape from gender roles which was to be punished. There has been much debate over whether this event should be accorded any cultural significance beyond that of random tragedy. Despite efforts by the mainstream media to particularize the event, women's advocates claimed the massacre was simply the most visible instance of the political killing of women, arguing that in that same year, 119 Canadian women had been killed by men in acts of domestic violence[5], many for allegedly departing from accepted, narrowly-defined gender roles. All those who study violence against women know that to choose independent or rebellious behaviour puts women at great risk, and yet those who urge women's increased MST participation often fail to make the linkages. Are women who are told to protect themselves by not venturing onto man's streets after dark to believe there are no consequences to venturing into man's world?

Following the massacre, a number of new initiatives were fostered. Ironically to some, the first wave of action did not focus on men or on male violence, but rather on contemplating the reasons so few women pursued engineering-related studies at the post-secondary level. Despite consistent denials that the massacre had anything to do with gender issues, the focus on women-and-MST intensified. Such a focus on women was perhaps inevitable; the "adjustment" of females in a society well-trained to see women in need of repair was still familiar and safe territory, at least when compared with discussing whether engineering or even men themselves might be considered part of the problem.

Yet since December 6, 1989, those who condemn the violence against women have had an unforgettable event to commemorate. The forced separation of the issues contributing to the death of these women and to the death of hundreds of others could not be sustained. The Canadian Panel on Violence Against Women was struck; men initiated the White Ribbon campaign as a way of commemorating the massacre victims and making a public commitment to end violence. As one of the

early post-massacre initiatives, the Federal Government and the Engineering Society sponsored the Canadian Committee on Women and Engineering, which released a report that, while far from radical, nonetheless demonstrated enormous progress in understanding how gender dynamics, rather than thermodynamics, operate to exclude women from the creation and practice of science.

The convergence of these two strands of women's experience - exclusion from the power associated with directing and using MST, and the exclusion of women from experiencing their own power because of violence and control by men - has opened many eyes to the recognition of the connectedness of the issues which control women and women's choices. It is no longer tenable to believe that the world can remain exactly as it is, sexism intact, except that women will enjoy full participation in MST. The notion that our schools can remain the same, sexism intact, except for MST classes, is equally unsustainable. It is through recognizing the connections across issues and domains that real progress will be achieved.

Gendered Science

Gendered Science; Gendered Schools

In Women Scientists in America: Struggles and Strategies, Margaret Rossiter describes the catch-22 of the female scientist. By definition, she must be anomalous in two ways, as a scientist and as a woman.[1] It follows that reconceptualizing either construct without rethinking the meaning of both would be to miss the point.

3.1 Is Science Male?

> *"Once we recognize the link between knowledge and understanding we also recognize that knowledge is not neutral, objective or value free. It is impossible to assume that science, technology, mathematics or any other knowledge-seeking activity is neutral, because search, selection and construction of new knowledge begins with questions -- and questions arise in a given setting. Questions make sense only in a particular social and political context. ... Scientists are the socially sanctioned fact makers. However, scientists constitute a very small and homogeneous social group which in the past was almost entirely male, almost entirely white and schooled in similar settings using similar or identical texts. Yet, as their insights and the results of their research become "facts", they shape the whole society. On the other hand when those who work outside the in-group of scientists -- say women who nurse, cook or garden -- bring forward observations and insights, however well tested and verified, these contributions rarely achieve the status of facts." [Ursula Franklin][2]*

The very notion of challenging science, with its claim on verity, laws, and predictability, can seem heretical. Yet one need not be dependent on the new physics to understand that in science, as with most other human endeavours, purposes control outcomes. In the case of science, its purposes and priorities can be tracked to observe how science has been conceptualized and directed to the interests of males. Sir Frances Bacon, unimpeded by political correctness, wrote in 1623, "The scientist should subject nature to his needs, make her a slave and give her form ... to find out her intrigues and secrets."[3]

While some things change; some do not. Science is still used to solve problems as they are set by the dominant interests of every culture, most of them male, expansionist and military. Had those interests framed health and wellbeing or the preservation of our environment as priorities, our planet might be very different. The "research agenda" of western science is accused of neglecting women's

concerns, from silicone implants to breast cancer. Enough has been said about the common language used to describe Nintendo, the Gulf War and the Superbowl to ensure easy recognition that technological triumph and testosterone are hardly strangers.

This kind of observation requires us to ask not just "what is it about girls that keeps them away from science?" but "what is it about science - and the teaching of science - which excludes girls?"

Authors such as Keller[4] find a common thread between the psychology of masculinity, which is often presumed to rest on separation, and science's bias towards "hard facts", replication, and separation between the observer and what is observed. Scientific objectivity, elevated to a virtue as well as a necessity, neatly obviates the discomfort of emotion and engagement. In contrast, researchers including Gilligan[5] and Belenky[6], characterize women's interests and styles of learning as tending to value the connections between the emotional and the rational, and between the knower and the known. Such world-views require a recognition of ambiguity, the substitution of contradiction in place of certainty and awe in the place of mastery. Many argue it is lack of respect for these world views which has permitted our disastrous attempts to master nature and each other, and created our blindness to the connectedness of the natural world.

Some claim that the traditional teaching of science reflects not only a reverential dependency on certainty and truth, but also a replication of hierarchy, with the teacher firmly established at the top of the pyramid, without whom the understanding of the subject matter would be impossible. And certainly, many students perceive the truths of MST to be inaccessible without the mediation of the teacher, text in hand, at the front of the room. The religious analogy is hard to avoid; reverence is expected, and thus to ask a "dumb" question is not only to reveal one's own insufficiency but also to insult the intelligence of the teacher. It is the student's role to accept "truth" as it is revealed whether or not it is understood. Salvation is elusive; success, at least as it can be measured by grades, is not the key to feeling able or competent. Especially for girls, an "A" is not confirmation of ability or aptitude but at best recognition of diligence.[7] It is not through one's own efforts that success is attained in this unfamiliar setting, but rather through the grace of good fortune.

The problem is that with the exception of a few individuals with the status of Dr. Franklin, these criticisms are hurled at science by those with limited direct experience with the nature of the scientific paradigm. When critics lack this kind of first-hand knowledge, their criticisms are easily dismissed. Regrettably, there are not enough scholars whose domains include accomplishment in both feminist theory and the realms of science, and even fewer who add to this expertise an

interest in feminist pedagogy. Avoiding or dismissing science as "male" and immutably so is as dangerous as labelling childrearing "female". While without question the dominant gender preoccupied with these domains has shaped the values of each, to dismiss either as unworthy pursuits because of this association is to accept a status quo which has not served women well.

Critiques of the gendered values of science are necessary and valuable, but they must not lead to arguments which suggest that science is wisely excluded from the collective concerns of women. To choose to be detached from the knowledge of science is to choose a form of illiteracy which excludes the ignorant or disinterested from the great practical and moral debates of our times. The possibility of reframing our thinking about science, as well as reframing the purposes to which science will be directed, can only be accomplished through focused will and effort. The scientific concept of inertia applies; Newton's first law requires that force must be applied if the condition or direction of the object is to be altered, but this only works if the force reaches the object in question. Criticism which can be deflected or ignored will have no effect. The purposes and values of science will have to be shaped, at least in part, by those within as well as outside the discipline.

3.2 The Gendered Classroom

The foundations of modern schools claim to be rooted in egalitarian principles. Public education, available without distinction to every child, was conceived as the means of transcending the limitations associated with poverty, race, class and circumstance. The lack of success of our current system to achieve this goal is variously attributed to ineptitude, lack of commitment to the goal itself, or an overly optimistic assessment of the power of the classroom to overcome all other variables influencing a child's life.

It is worth noting that until recently the foundational egalitarianism of the classroom has not recognized that limitations arising from gender might be among those addressed by the school, nor is this goal universally acknowledged. Since the most fundamental issue of access was seen by some as a sufficient recognition of women's right to education, little else was required. Modern waves of reform have focused narrowly on girls' right to be treated in the same way as a white able-bodied male would be treated.

Such limited definitions of educational equity have been called gender-neutral, and are commonly characterized at the school or system level by goal statements such as "to help each child achieve her/his potential, regardless of sex." Statements framed this way have been used to prevent the implementation of gender-specific initiatives which would move schools towards more appropriate responses to the

gendered lives of students. In focusing attention on intention, rather than outcome, the great majority of gender-based inequities which are either unintended or unrecognized are allowed to persist. Nor is "sameness of outcome" necessarily the most appropriate goal with respect to gender; some would argue validation of certain differences rather than harmonization is a more enlightened definition of gender equity.

To move to either of these states, however, requires a recognition that differences exist. The issue of recognizing the effects of gender is particularly problematic, since one of the characteristics of the social construction of gender has been the invisibility of its dynamic, especially to those who find themselves among those most damaged or most privileged by its effects. The right of those with vested power based on class and gender to dismiss challenges to this hegemony has been called "the right to not know", and this right is exercised regularly by those in a position to make a difference. Ontario research, for example, suggests that fewer than 1% of graduating teacher education students have been exposed to even the most cursory consideration of gender issues in education.[8] The centrality of gender need not be denied when it can safely be ignored.

The body of research literature on learning styles, instruction, priorities of the curriculum, teacher-student interaction, remediation and enrichment, diagnosis of emotional and learning disorders, use of teacher time, reinforcement, questioning styles, distribution of power in group work, teacher expectations, discipline, evaluation and virtually every other sub-species of educational inquiry capable of being examined from the point of view of gender is now voluminous, quite conclusive and, until recently, safely ignored by theoreticians and practitioners.[9] While the evidence of the systematic skewing of all these elements in favour of boys has mounted, the obligation felt by those who direct policy or the priorities of education to address these issues in any but the most cursory way has been negligible. As Myra and David Sadker note, a 1989 review of the voluminous literature on school reform subjected more than 60,000 lines of text to content analysis. They found less than 1% of the text dealt with gender-equity issues.[10]

Recently, however, some would claim there has been a discernable shift in recognizing the need to do more than practise a politically-correct avoidance of overtly sexist school policies. Gradually (and more gradually than in any other profession) some women are achieving positions in education systems which allow them to demonstrate both managerial competence and a particular concern for the wellbeing of female students. As the profession ages, male teachers may be more compelled to consider equity issues through the eyes of their teenage daughters. There is a growing intolerance for behaviour which substitutes labels and ridicule for informed discussion. Well-written and thoroughly researched publications have been launched strategically and have engaged a non-academic audience

concerned with equity issues. The relative receptiveness to this kind of critique is no doubt encouraged, in part, by the "economic imperative" argument skilfully used by their authors. Such general receptivity, however, must be nurtured by knowledge as well as encouragement. While an overview of all the documented effects of gender on teaching and learning is well beyond the scope of this paper, perhaps an introduction to some of the issues identified in one area will suggest the multiple possibilities for intervention.

3.3 Computer (in) Equity

Personal computers are marketed to the public as an empowering technology; current T.V. commercials rhythmically chant "everybody's got the power", while people of diverse ages, races, circumstances and both genders enjoy the benefits of microchip technology. Yet, research suggests that in some classrooms, at least, computers are intensifying rather than ameliorating the gendered balance of power. In reviewing the pertinent research on gender and computer learning, June Mark reports:

- *Gender differences have been documented in both computer use and access; girls are more likely to use computers for word processing and boys for programming.*
- *Boys are more positive than girls about computers, finding them more "enjoyable", "special", "friendly", and "important" than girls.*
- *The gendered "computer gap" starts at middle school and widens as students age;*
- *Girls tend to have less confidence than boys in their use of computers; both boys and girls see computers as part of the "male" domain.*
- *Use of computers outside school show even greater gender differences: boys are three times as likely as girls to attend computer camps and summer courses.*
- *Prior to formal computer instruction, one study found 60% of boys said they "knew" computers compared with 28% of girls. Access and familiarity are important correlates with positive attitudes.*
- *Because computers tend to be clustered in the mathematics/science areas (to which girls may be less attracted, and areas which are staffed predominantly by male teachers) neither male nor female students are regularly exposed to adult females using computers.*
- *Both the nature of the software and the design of learning experiences have been found to influence gender-outcomes. Word and puzzle games appeal more to girls than competition-focused software; collaborative rather than independent activities are preferred by female students.*[11]

Sandra Acker and Keith Oatley take this analysis further, citing research which suggests:

- *Boys have been found to "aggressively" exclude girls from computer use or confine them to "helper" roles.*
- *Females stay away from computers because of their association with clerical work, fearing their options will be limited and their prestige diminished if they become proficient users.*
- *Girls exhibit the "we can but I can't" paradox, defending girls' abilities in general but doubting their own competency.*
- *Teachers clustered in MST subjects in Britain were found to be among the least likely to be in favour of equity initiatives or, if they supported them, less inclined to take an active, interventionist approach.*
- *A boy-centered "computer culture" can develop in classrooms, particularly when free access of computers and computer use in free time is encouraged. This would appear to reinforce the dominance of boys who in less-supervised situations may compete more successfully for computer use and more actively discourage girls' involvement.*
- *Although girls prefer cooperative work groups to individual "computer-mastery" tasks, mixed-sex work groups can exploit more able girls as "worker-bees" and relegate the less-assertive to note-taking.*
- *In one Ontario study, boys hoarded resources, manipulated their teacher and female classmates in such a way as to guarantee girls' perpetual frustration and disadvantage. The teacher was aware of the "boy-girl" situation, but didn't intervene. This pattern of aggressively marginalizing girls is repeated in many studies.*[12]

The authors sensibly note that awareness of these disturbing features of computer-use does not constitute a blueprint for action. However, little useful action is likely unless it is grounded in an acceptance of identified problems. Just as innovations in other spheres are developed carefully to reflect, at least in theory, the complex change processes which characterize schools, equity innovations require the same respect for complexity and the same tolerance for a rocky road to improvement.

3.4 The Question of Voice

Beyond the litany of specific ways in which girls are systematically disadvantaged in the classroom, several themes of discourse are emerging. Some focus on what is said and what is happening, while others address the issues which are evaded and what doesn't happen in the classroom. This is a theme of absence and silence. In a poignant essay on women's education, Carol Gilligan observes:

> *"... adolescence is a critical time in girls' lives -- a time when girls are in danger of losing their voices and thus losing connection with others. It is also a time when girls, gaining voice and knowledge, are in danger of knowing the unseen and speaking the unspoken and thus losing connection with what is commonly taken to be "reality". This crisis of connection in girls' lives at adolescence links the psychology of women with the most basic questions about the nature of relationships and the definition of "reality". Girls' questions about relationships and about reality, however, also target women's silences." [Carol Gilligan]*[13]

This theme of silence is pursued by Catherine MacKinnon, who also notes that voice is an issue of power:

> *"... power constructs the appearance of reality by silencing the voices of the powerless, by excluding them from access to authoritative discourse. Powerlessness means that when you say, 'This is how it is' it is not taken as being that way. This makes articulating silence, perceiving the presence of absence, believing those who have been socially stripped of credibility, critically contextualizing what passes for simple fact, necessary to the epistemology of a politics of the powerless." [Catherine A. MacKinnon]*[14]

In this context silence is not lack of noise, nor is voice the same as contributing words. Educators must become aware of how female students have accepted the inevitability of classroom inequity, and even how many have chosen the path of denial as more comfortable than the path of awareness. Teachers must address their own complicity if they have chosen the same solution.

We are called on, then, not only to note what happens in the classroom, but what doesn't happen; not just what is said, but what is meant by the silence of our students. Becoming aware of the presence of absence is not the same goal as treating each student the same. Teaching girls to succeed in a masculinist classroom is not the same as developing an anti-sexist classroom. No checklist can evaluate what is not happening, nor the price of silence.

Beyond the non-sexist or anti-sexist classroom exists a context which is being explored but which is not yet fully defined. Theorists and practitioners are beginning to ask what would constitute a girl-friendly school. Just as peace constitutes more than the absence of war, surely a girl-friendly school requires more than the absence of gender hostility.

For many, the most obvious answer to the problems of absence and voice is the creation of girls-only classes and schools, and there is ample evidence that single-sex settings benefit young women's academic and personal development. Numerous experiments not limited to prestigious private schools are being undertaken, and their success is tempting. Yet it is enormously discouraging to conclude that the only setting in which female development can be nurtured is one in which males are absent. There is something quite defeatist in this approach; an acquiescence to the inability of society to insist that men change too; an acquiescence to the perpetuation of male prerogative. Awareness of the presence of absence cannot be relegated to women and their daughters; men and their sons must quiet their voices and listen, too.

The Quality of Girls' Lives

The Quality of Girls' Lives

If the purpose of engaging more young women in the study of MST is only to win macroeconomic battles, then consideration of the quality of girls' lives is not pertinent to this discussion. If the classroom is the only venue which needs to change, perhaps it is also irrelevant. But if instead participation and success in MST are encouraged because they will enrich girls' lives, then their quality of life now must be the starting place.

Several recent major studies provide complimentary snapshots of adolescent girls, although there is danger in over-generalizing about the characteristics of this group. Sweeping statements can ignore the great diversity of young women and their circumstances. "Gender generalizations" can mask the particularities of race, culture, disability, class, family circumstances and endless variables which profoundly shape quality of life. Research which considers multiple variables, i.e. "the self-esteem of recent-immigrant urban female adolescents" is close to non-existent. If one is black, a wheelchair user and an adolescent female, it would be inappropriate to conclude that one's experiences and world-view were shaped only by gender, yet gender is far from irrelevant in such a woman's life. These complexities deserve greater research attention, but also careful attention from those who wish to work with young women and on their behalf.

4.1 A Cappella

A Cappella: A Report on the Realities, Concerns, Expectations and Barriers of Adolescent Women in Canada was published by CTF in 1990.[1] It reported on the results of a participative research study involving more than 1,000 girls in conversations with each other and their teachers. Among its findings:

- *Many girls based their self-esteem in their mastery of "people skills", and considered issues largely in terms of how others were affected by actions and events.*
- *Girls equated their growing sexuality with increased risk, vulnerability and hassles.*
- *Girls reported being very susceptible to the opinions of others. Discord, disapproval and criticism, especially of their capabilities or appearance undermined feelings of self-worth.*
- *Most girls were fully aware of the likelihood that they would need to earn a living most of their lives. They tended to see this as an overwhelming "add-on" to maintaining relationships, caring for a family and negotiating an unfriendly world.*
- *Many girls indirectly yearned for "the evaded curriculum" when they criticized teachers and schools. The experience of "really talking" with a*

teacher seemed extraordinary and positive for both students and teachers.

- *Many girls reported feeling greatly stressed by the competing priorities of family responsibilities, friendships, romantic relationships, part-time jobs and schoolwork. Boys were not seen as having as much to worry about, or as taking life as seriously.*
- *Despite a strong sense of "unfairness" in the present, girls were unlikely to commit themselves to viewing the world of work they would inhabit some day as biased against women.*

These implications and findings should inform MST strategies. For example, the frequently-voiced criticism of "irrelevancy" to describe the sciences should perhaps be heard as a critique of the curriculum's preferences for pulleys over people. Since self-esteem for girls requires that others value them "for themselves", and not only for their capabilities as students, the classroom should provide opportunities for students to demonstrate people-skills as well as computational skills, and to have these valued as well. The findings should reinforce our determination to refuse to tolerate hostile teasing and banter, particularly when it comes from male students.

The focus of female-directed career discussions in the classroom, perhaps particularly in MST-driven programs, has been on career awareness, with an emphasis on the evaporation of knights on white horses and the severity of the female poverty rate. This message, well-intentioned though it might have been, has not only registered, but seems likely to have frightened and disempowered young women more than it has motivated them to do well. Fearing they can't have it all, many seem resigned to having nothing. As they see their mothers struggling to balance conflicting priorities and, they report, see men and boys "getting off easy", many young women seem to be choosing not to play the game.

Ironically, in trying to convince young women that "they can be anything they want to be ", we may have substituted our desire for how we want the world to be for how it is. Believing that workplace and career equity exists "somewhere out there" could, perhaps, be empowering if it means that as they mature into young adults, girls will settle for no less than equal treatment. However, believing gender equity has been achieved can make one's own experience seem anomalous, and can turn experiences such as sexual harassment or a gender-motivated denial of promotion into events for which one is somehow personally responsible. Denial of systemic bias is not empowering; to tell a young women that sexism no longer exists on construction sites or in higher education is to do her no favour.

Girls' resistance to feminist labels is a challenging issue. On the one hand, young women quite clearly want the goals of feminism to be achieved, but many are wary of being identified with the movement to achieve these goals. To be female seems

"bad enough" to some, to be visibly angry or resistant is to invite even more problems. This reluctance to "step out of line" may well be related to young women's frightening familiarity with violence. As Peter Jaffe points out:

> *"Violence or fear of violence is part of the daily reality of every Canadian girl. The violence may come in the form of sexism, racism, intimidation, physical abuse, sexual assault and verbal, emotional or psychological abuse. The violence is so much a part of the landscape that many girls suffer in silence and assume the violence is inevitable."*[2]

Sometimes the violence in girls' lives is directed towards them; often it is towards their mothers. Young girls who grow up witnessing violence are prone to significant emotional and behavioral problems. But girls are not just bystanders to violence: the Badgley Commission concluded that one in two girls would be sexually assaulted before they turned 18, usually by someone with whom they shared a "trust" relationship.[3] One in nine Canadian girls reports that she has been physically or sexually abused in a dating relationship,[4] and this is in a context where girls under-identify assault, preferring to shoulder blame for "letting him go too far" rather than naming the assault and victimization for what they are.

The school's reluctance to deal with issues such as these prompted CTF's publication of Thumbs Down! A Classroom Response to Violence Towards Women in 1990.[5] This attempt to deal with this part of the "evaded curriculum" of girls' lives has been praised for its objectives and content, but it seems to have been used more widely outside than inside schools. As denial of the prevalence of violence in girls' lives becomes harder to sustain, teachers, boards and ministries must address the sanity of the rationale we use to insist quadratic equations have an entitlement within the curriculum which anti-violence education does not.

The research begun in A Cappella has led to a number of important initiatives. CTF is currently designing and implementing a multi-faceted project intended to develop a network of committed and well-placed individuals within each province and territory. The networks will initiate or encourage school and community-based interventions to improve the quality of girls' lives. Detailed background papers on the themes identified in A Cappella, including self-esteem, violence, career plans and the culture of schools are in preparation as part of this project.

4.2 We're Here; Listen to Us

In 1992, the Canadian Advisory Council on the Status of Women published the results of an extensive survey of 13 to 16 year-old male and female youth.[6]

Among the results:

- *Twice as many young women as young men said they didn't feel good about themselves.*
- *The gender gap in self-confidence increased with age.*
- *Almost one in five young women said they had been sexually abused.*
- *By age 16, 61% of young women said they were under great stress.*
- *Only 3% of young women didn't expect to finish high school.*
- *Ninety-four per cent of young women said doing well in school was important to them, but only 66% said they liked school.*
- *Sixty per cent of young women said they spent five or six hours a week doing homework, compared to 44% of young men.*
- *Girls identified both personal and global concerns with equal frequency when they described what they would change about the world.*

These findings, together with the entire report, suggest that girls are highly motivated to succeed, but perhaps they are likely to avoid subjects which add disproportionately to their levels of stress, hours of homework, or which erode an apparently fragile self-concepts. While selling MST as "tough but worth it" may improve the prestige of these courses, many girls, who despite ability tend to underestimate their own success at new tasks, may be discouraged and hear such descriptions not as a challenge but as a threat. Again, a more altruistic definition of the purposes of science, for example, in solving global and environmental problems rather than as leading to prestigious career choices may better connect with young women's value systems.

4.3 The Health of Canada's Youth

This 1992 publication[7] from the Government of Canada suggests that not only are Canadian girls at greater risk than boys on a number of health indicators, they are at greater risk than their international counterparts, and there is a measurable decline in their health status from ages eleven through thirteen and fifteen. Findings such as these ought to alarm all those interested in the quality of life of Canadian youth:

- *The percentage of girls who believed their teachers thought their work was "very good" or "good" declined from 32% to 22% between the ages of 11 and 13. Boys registered only a 2% decline during the same period, from 22% to 20%.*
- *Girls at each of the age levels (11, 13, 15) were more likely than boys by an average of nine percentage points to agree there were one or several teachers they feared.*
- *Between 25% and 39% of both boys and girls said they feared one or several students, with Canadian girls, by age 15, the most likely in the seven-*

country sample to admit they were frightened.

- *For boys at ages 11 and 13, 74% agreed with the statement "I have confidence in myself". For 11 year-old girls, the percentage was 66%; by age 13 it had declined to 54%, a level which was only 2/3 of the score of boys of the same age.*
- *Forty-eight percent of 15 year-old females wanted to lose weight, compared with 19% of 15 year-old males.*
- *Fifty-eight per cent of 15 year-old females said they "often" or "sometimes" felt like outsiders. Both males and females, at every age level, were more likely than students from 9 other countries to say they "often" or "very often" felt lonely, with 15-year-old Canadian girls the most likely of all to say they were "very often lonely".*
- *Canadian girls at 15 were less likely than 15 year-old boys to say they felt understood by their parents, and were more likely to say they wanted to leave home. They were less likely to say they had a happy home life, less likely to feel trusted by their parents, and more likely to say they had a lot of arguments with their parents.*
- *At every age, Canadian students, male and female, were the least likely of those from 9 countries to agree that they could "talk to their fathers about things that really bother them." This was most difficult for 15 year-old girls, with only 36% agreeing with the statement.*
- *Canadian girls at age 15 were almost twice as likely as boys to have taken medication for "sleep difficulties" and "nervousness".*
- *At both ages 13 and 15 girls were two-and-one-half times as likely as boys to say they had felt depressed "often" in the previous six-month period.*
- *Eleven-year-old Canadian boys were five times more likely than girls to spend four or more hours per week playing computer games.*
- *Only 11% of 15 year-old Canadian girls thought of themselves as "very fit" compared with 29% of their male counterparts.*

The research provides confirmation of the precipitous decline in self-esteem found by others to characterize girls between the ages of 11 and 13, a decline from which they do not recover. Girls perceived their teachers as being displeased by their work, and many were afraid of at least some teachers. Yet girls' sense of self-esteem is not drawn primarily from accomplishment but from appearance; girls' preoccupation with body image leads some to a fixation on dieting and weight loss, behaviours accompanied by a deteriorating sense of fitness. As Naomi Wolfe points out in "The Beauty Myth"[8], the consequences of such a fixation are not just emotional but also intellectual and physical. She claims that the majority of American college-age women have eating disorders of sufficient severity that powers of memory, concentration and ability to learn are actually impaired. There is no reason to think the Beauty Myth has any less impact on teenage girls, or has any less profound effects.

While many writers have explored the longing for connection in adolescent girls' lives, rarely have we encountered exactly how many girls feel like "outsiders" in their classrooms, families and, in particular, with their fathers. Yet when "inclusiveness" with respect to schools is discussed, the debate is usually restricted to the important question of how schools can respond to and respect cultural diversity. This study introduces another agenda; there is evidence that girls too have a unique culture, and one which they do not see valued by others.

The mental health indicators of anxiety and depression girls reported raise questions about how gender stereotypes affect identification, intervention and treatment of emotional disturbance. The Ontario Child Health Study[9] found that teenage girls were the least likely of all students to be referred for counselling and psychological services. While it is true that disturbed young males tend to act-out and thus draw attention to their behaviour and emotional states, it appears that either our perception that depression is a natural state for young women, or else our lack of awareness of their state, contributes to routinely ignoring the misery many female students are experiencing. Since schools are prime health/psychological referral agents, it is necessary to be particularly vigilant in not allowing self-effacing girls who consider themselves "outsiders" to be overlooked.

In considering the contribution of the MST classroom to girls' quality of life, it is worth remembering the quotation from Margaret Rossiter which began part 2, to the effect that to be a female with an interest in science was to be doubly anomalous, doubly an outsider. Girls' fear of being seen as "the other" may disincline them to take part in programs which are seen as unusual for girls, or to aspire to non-stereotypical careers. In a moving essay on girls' education, Emily Styles refers to curriculum, at its best, as providing both windows and mirrors.[10] Mirrors allow one to see oneself, reflected, but also to see others like oneself who have achieved great things. Windows allow one to see the world as it is and as it might be. For too many girls, the mirrors of the curriculum do not offer familiar images or images of women achievers unless these women are labelled as exceptional. Worse still, neither teachers nor texts encourage students of either sex to reflect on why this might be so. The windows through which young women are allowed to look show someone else's idea of the best view; often there is only one view, one history, one path. The MST classroom must overcome a masculinist history through finding new mirrors and windows if it is to present young women with a glimpse of the possible.

4.4 Shortchanging Girls, Shortchanging America

This American study conducted in 1990[11] undertook a nationwide poll to assess self-esteem, educational experiences, interest in mathematics and science and the

career aspirations of girls and boys ages 9 to 15. Sponsored by the American Association of University Women, this study has drawn a remarkable amount of attention from policy-makers and practitioners. It focuses our attention on the critical coincidence of a crisis in self-esteem, particularly experienced by young women, with a time in which decision-making regarding course options, if not career choice, is taking place.

The key findings of this study conclude:

- *The gender gap between male and female self-esteem increases with age. More boys than girls enter adolescence with high self-esteem; more young women than young men leave adolescence with low self-esteem.*
- *In the years between elementary and high school, self-esteem in girls falls 31 percentage points.*
- *Boys were more likely than girls to say they "do things well", to say they "speak up in class a lot" and to "argue with teachers" when they think they are right. These gaps increase with age.*
- *Boys tended to base their self-confidence in talents such as an ability in sports. Girls were twice as likely as boys to mention a physical characteristic as the "thing they liked best about themselves", a gender-difference which is greatest during the middle school years when girls' self-esteem is declining most rapidly.*
- *The greater self-esteem among males translated into higher career dreams, and greater confidence that these dreams will come true.*
- *Girls, who begin with lower aspirations, were less confident than boys that even their more modest career goals could be achieved, perhaps because girls were much more likely to say they weren't "smart enough" or "good enough" to achieve their ambitions.*
- *Within this sample, black girls left elementary school with higher self-esteem and finished high school with their self-esteem relatively intact. Hispanic girls, however, who scored even higher on the self-esteem index than black girls in the youngest age groups, experienced the most dramatic decline in scores during high school. Both black and hispanic girls scored above white girls by the end of high school.*
- *Family and school influences rather than peers had the greatest impact on students' self-esteem and aspirations. Gender differences were reported on how students perceived adults' expectations of their competence.*
- *Especially for girls, feelings of academic competence correlated strongly with relationships with teachers. Academic pride bore the strongest relationship with self-esteem in girls, but this was an increasingly dangerous liaison: by high school, only 12% of girls said they felt pride in their schoolwork.*
- *Mathematics and science were found to have a strong effect on female self-esteem. At elementary grades, for both males and females, confidence in and liking for mathematics and science were high. High school students said they still "liked" mathematics, but their confidence in being "good at" mathematics was declining, much more dramatically among girls.*
- *Boys who disliked mathematics tended to blame the subject itself (i.e. it*

"wasn't useful"). Girls were more likely to blame themselves for their mathematics problems (i.e. they weren't "smart enough" to understand it).

- *Interest in science showed similar patterns, but girls were more likely than boys to find science "not interesting", boys were more likely than girls to find it "not useful".*
- *Students who "liked" mathematics and science were more likely to aspire to careers in these fields or to name other professional occupations. This was particularly true for girls, who also tended to have higher levels of self-esteem than girls who "didn't like" mathematics and sciences. For example, girls who liked mathematics were more confident about their appearance than all male subgroups, and more confident than girls who didn't like mathematics.*
- *Both males and females who liked mathematics showed greater confidence that they would achieve their career goals, although these goals still showed strong gender-stereotypical preferences. At high school, 52% of the boys believed they would enjoy being a scientist compared with 29% of the girls.*

There are, of course, certain limitations in applying the findings of this study in a Canadian context. Regrettably, despite alleged interest by many sectors to better understand girls and MST, CTF's proposal to replicate and expand upon this study has been unable to find a funding sponsor in the public or private sectors.

There are some challenging issues for schools raised by the findings of "Shortchanging Girls". Apart from confirming the self-esteem patterns already discussed, the strong linkages between liking oneself and liking mathematics/science deserve attention. Appreciation for mathematics/science appears to be reasonably well established in the elementary grades, but by high school it appears that for girls this affection becomes influenced more by perceptions of self rather than perceptions of mathematics and science. Girls seem difficult to convince that they can do something well unless they "like it", and unconvinced that even when they are successful (in terms of grades) that they are, in fact "good at" mathematics and science. For those for whom a breakthrough in a sense of efficacy as well as achievement can be made, there are enormous benefits in self-esteem and career confidence to be gained.

Teachers might be well advised to consider "attribution theory" within this context. In general, it appears that when girls do well at a task (for example, score well on an exam) they tend to attribute their success to luck or hard work. When they do poorly, they end to internalize the responsibility, blaming themselves for not studying the right things or, often, to being not smart enough to do better. Conversely, boys tend to credit their personal ability (rather than effort) for success, and externalize blame for failure (for example, the test was too hard, the teacher didn't explain the work, etc.).[12] Thus praising a girl for success on an exam will not necessarily result in her benefitting from the compliment if she is

internally dismissing her own role in the achievement. Praise must be directed not only to accomplishment but to ability, expressed through high expectations and recognition of everyday competency in many domains and not just for high marks.

The extent to which a better understanding of the quality of girls' lives can be blended creatively with MST initiatives will determine their success. While it is easier to segmentalize girls' MST attitudes and behaviours and attempt to address them without the additional complexities of health, violence, self-esteem and the evaded curriculum, interventions based on narrow definitions of "the problem" will be short-lived and relatively ineffectual compared with those prepared to view girls' experiences both inside and outside the classroom more holistically. In recognizing the complexity of the issues, it is important not to conclude that girls are little more than collective victims who need to be rescued. This urge is understandable but not helpful if long-term societal change is to be sustained. For example, while it is of critical importance that the needs of girls who experience violence be recognized, it is not "girls" who are the personification of the societal problem of violence against women. It is the society which is causing a crisis in girls' lives which needs changing for more than girls themselves. Given the realities of their lives, they need support much more than they need remodelling.

Decoding the Data: Part I

Decoding the Data

Part I

5.1 Tests and Testing Biases

The attention once reserved for measuring girls' "participation" (enrolment) in MST courses has begun to shift to "success" (achievement). As discussed in section one, complex indicators of "success" for students and for education are frequently and inappropriately reduced to single-test numbers. References to test scores, particularly in international contexts, play an important role in politicizing education and determining the direction of education reform. But the political is also personal. Test results become more critical as students mature, with minute score differentials determining not only which students will pass particular courses but also which students will be admitted to select universities and receive scholarships.

The widespread impact of Canadian participation in international (and soon, interprovincial) comparative testing illustrates one kind of testing bias, which in this case is shown by a very selective reporting of results, and their use in bolstering some highly questionable conclusions. The Economic Council of Canada gave schools a failing grade in "A Lot to Learn"[1] by basing its conclusion, in part, on poor student performance on international MST tests. Yet the Council might have heeded its own working papers which state: "the existence of such fundamental differences in the makeup (of the tested population) and in the content of the curriculum makes comparison of the outcomes attained by students highly problematic."[2] The authors also determined that Canada's retention rate means that 82% of the tested population cohort was still attending school. Depending on the province, between 38% and 55% of these students were enroled in the designated mathematics courses which were tested. While 92% of Japan's comparably aged students were still in school, only 13% of this group was enroled in the mathematic courses from which Japan's sample was drawn.[3] In other words, it can be assumed that a much broader distribution of ability characterized the Canadian sample than that of Japan or of any other participating country. Such important variables are rarely reported when "testing" makes the news. Clearly there are many complex issues rarely addressed in facile comparisons of success rates. Among these issues is the growing body of evidence that female students fare less well on standardized examinations than boys.

Of course, differences between male and female achievement do not necessarily demonstrate bias. It should be remembered that one group may genuinely know

more about a particular content area than another group. Any bias is thus the result of the kind of knowledge which is valued, rather than bias in favour of or against a particular group. However, if a test fails to meet the criterion of validity, that is, if two groups know the same amount about a subject but one group consistently scores higher on a test alleged to evaluate that knowledge, or if a test fails to identify the superior level of knowledge of one group over the other, then such a test can be said to be biased.

Do the following facts, drawn from a survey of research cited in How Schools Shortchange Girls,[4] constitute evidence of gender bias in testing?

- *Despite girls' higher grades in high school and college, boys were found to be twice as likely as girls to have received a scholarship based on standardized high school test scores.*
- *Girls have consistently outscored boys on the SAT-verbal when the content refers to concepts and ideas rather than things, or to aesthetics, philosophy, relationships and stereotypically female tasks. Males have scored best on verbal items relating to science or sports. Since the 1978 revisions to increase the number of science-related items in the SAT-verbal, reading subscores favouring boys have increased from three to twelve points.*
- *Recent U.S. reforms described as conscious attempts to make testing more "gender-neutral" have in fact disadvantaged women. Women's previous slight advantage (3 to 10 points) on the SAT-verbal has shifted to males as a result of revisions to the questions. It is worth noting that no revisions to the SAT-mathematics, in which men enjoy a 50-point advantage, have been undertaken.*
- *SAT scores under-predict the success of young women, and over-predict the success of young men in college/university achievement, especially in mathematics.*
- *Bias in test items can occur within content, format and the skill or knowledge area being tested. For example, in the general area of mathematics, girls will tend to score higher on computational tasks, algebra and logic. Boys will tend to score higher on problem-solving and geometry. Tests which give more weight to one cluster of skills over others will produce gender differences.*
- *Girls have been found more likely than boys to omit test items with unfamiliar content; they tend to do best on tests closely aligned with the curriculum. Boys do better than girls on unfamiliar or "real life" problems.*
- *Girls tend to score higher on essay and open-ended items; boys tend to score higher on multiple choice items. Girls complete fewer items than boys, have been found more likely to not finish tests and more likely to choose "I don't know" as an answer when it is offered.*
- *Girls have been found to score as well as boys on science process questions but less well than boys on science content.*

From this data it cannot be claimed sex-bias disadvantaging girls is present in every Canadian MST evaluation. However, it is curious to note how little attention is paid to the apparent risk to young women posed by a massive shift to computer-scored, single-right-answer standardized evaluation. Girls' preference for giving qualified responses, or even their tendency to work more slowly than their male peers is grounds enough to challenge test makers to demonstrate, in advance, that tests are gender-fair in areas of skill, content, context and format. When so much can rest on one or two percentage points, girls must have the right to these assurances, and the public must have access to information which ensures test-makers are held accountable for bias-free content and testing procedures.

Regrettably, the real possibility of gender-biased tests is rarely foremost (or even considered) in analyses of test results. For example, the Economic Council of Canada, in its report on the Second International Science Study (SISS, Working Paper No. 7)[5] notes in passing the higher success rate of males in all populations tested, and that girls outscored boys on only two of sixty sub-test comparisons. These results are not discussed, but merely noted as constituting "no exception to the general pattern." Working Paper No. 6[6] from the same series notes that test results are consistent with the narrowing gap between male and female scores, but claims to find girls' lower participation rates "puzzling", a choice of words which suggests the subject was not considered sufficiently important to review the available literature.

5.2 Jurisdictional Comparisons: Secondary Schools

What patterns emerge when jurisdictions next door or thousands of miles away compare data on student enrolment and achievement? Where are the patterns reversed? Why? Why is it so difficult to find information to unravel this complex issue? These are among the questions challenging every researcher working in the area of outcomes as well as theory.

As part of the information collected in the preparation of The BETTER Idea Book, a thorough search was conducted to identify current information on the performance/success rates of girls in MST subjects at the secondary level. No publications containing more recent national figures than those published in the Idea Book, 1988, were identified.

While post-secondary and labour force participation data were reasonably accessible, it was with great difficulty that the somewhat incomplete information which follows was collected. In each case Departments and Ministries of Education were asked to provide information, organized in the way in which they used it, on "participation and success rates, by gender, for senior secondary MST

courses". Some jurisdictions made available information they had published and circulated to their communities. Some provided reams of computer printouts. Some flatly stated they had no data, or no data to share. This inconsistency and the lack of a national data base is perhaps inevitable given the provincial/territorial role in elementary and secondary education. However, since several jurisdictions have very limited gender-specific data, and no other common national information source exists, one wonders on what foundation the attention to girls and MST has been justified.

The available data follow, organized by province and territory rather than by subject or grade categories, since there are too many unmatched variables to assume a common basis of comparison. Different measurements over different periods allow some possible analyses to be explored, but conclusions are subject to the limitations of speculation.

It should be noted that there is no basis for assuming that the "success rates" reported are based exclusively or even predominantly on standardized or even common examinations within or across jurisdictions, except in the cases noted.

Northwest Territories

Participation Rates: 88-89 - 90-91

	88-89		89-90		90-91	
COURSE	%F	%M	%F	%M	%F	%M
Biology 30	53.4	46.6	51.2	48.8	55.4	44.5
Calculus 35 *	--	--	100.0	0	100.0	0
Chemistry 30	43.7	56.3	43.1	56.9	51.88	48.1
Math 30	51.6	48.4	53.4	46.4	56.09	43.9
Math 31	23.1	76.9	31.5	68.5	41.17	58.8
Math 33	53.0	47.0	51.7	48.3	43.0	57.0
Physics 30	28.2	72.8	37.0	63.0	38.6	61.38

* Sample sizes are very small: 3 students in 90-91, 1 in 89-90, none in 88-89.

Participation, by gender, expressed as a percentage of course enrolment, selected years, N.W.T.

Success Rates: 88-89 - 90-91

Course	88-89		89-90		90-91	
	%F	%M	%F	%M	%F	%M
Biology 30	56	62	58	59	59	58
Calculus 35 *	--	--	79	--	75	--
Chemistry 30	61	66	61	64	62	64
Math 30	58	63	56	65	59	56
Math 31	87	75	83	74	75	65
Math 33	58	53	58	58	60	51
Physics 30	66	68	64	67	64	63

* Sample sizes are very small: 3 students in 90-91, 1 in 89-90, none in 88-89.

Average marks, by gender, expressed as a percentage, selected courses and years, N.W.T.

In the Northwest Territories, the participation rate of girls has increased over the 3-year period for which data were collected, but during 90-91 it was still below 50% on three of the six courses for which there is substantial enrolment. Given that school retention favours girls in all jurisdictions, a 50% participation standard should not be considered exact parity. Over the three years of "success data" provided, boys outscored girls on 10 of the 18 measurements, but on only 2 of 6 courses in 1990-91 by a total of only 3 points, compared with an 18 percent "mark differential" favouring boys in 1988-89. There would appear to be quite a marked increased in girls' participation in certain subjects, especially physics.

Newfoundland and Labrador

Participation Rates, 1990-91

COURSE	% FEMALE	% MALE
Biology 3201	58.8	74.7
Chemistry 3202	34.3	33.4
Advanced Math 3201	21.6	20.7
Academic Mathematics	57.1	55.7
Geology 3203	18.8	22.8
Physics 3204	30.1	41.2
Environmental Science	32.3	41.9
Computer Studies	44.4	46.5

Participation expressed as a percentage of students of each sex eligible by grade to enrol in each course, 1990-91, Newfoundland and Labrador.

At the grade 12 level, retention rates in Newfoundland/Labrador show slight gender differences favouring girls, and thus percentage differences in participation should be read with this in mind. According to this data (not adjusted for this disproportionality) male participation is greater in 5 courses, female participation is greater in 3, with the greatest gender difference of 15.9 percentage points to be found in biology 3201.

Success Rates, 1990-91

COURSE		PUBLIC EXAM (AV) %	SCHOOL & PUBLIC EXAM COMBINED %
Biology 3201	Females	49.9	61.7
	Males	51.9	62.0
Chemistry 3202	Females	56.8	64.7
	Males	57.2	64.2
Advanced Math 3201	Females	62.3	70.0
	Males	61.9	68.7
Academic Mathematics	Females	52.6	62.3
	Males	51.6	61.0
Geology 3203	Females	50.3	58.6
	Males	53.8	59.6
Physics 3204	Females	64.5	68.0
	Males	66.3	67.7
Environmental Science	Females	67.1	66.7
	Males	70.9	68.8
Computer Studies	Females	NA	NA
	Males	NA	NA

Average marks, by gender, on public exams and "combined" mark, 1990-91, Newfoundland and Labrador.

The method of computing success rates in Newfoundland/Labrador permits some usually unavailable data to be compared. In this province, "public examinations", as they are known, supplement school exams and are averaged to produce a final mark. For every course for which data were made available, except environmental science, the average public exam score was substantially lower than the average combined mark, indicating marks on teacher-set exams were considerably higher for most students than their scores on the standardized examination. While this tendency is more pronounced within certain subjects, the pattern is consistent. Also entirely consistent is the wider gap between "public exam" and "average" scores for girls when compared with boys, as the following table (derived from the table above) demonstrates:

Success "Differentials", 90-91

COURSE	% FEMALE	% MALE
Biology 3201	11.8	10.1
Chemistry 3202	7.9	7.0
Advanced Math 3201	7.7	6.8
Academic Math	9.7	9.4
Geology 3203	8.3	5.8
Physics 3204	3.5.	1.4

Difference between averaged scores and public exam scores, by gender, by course, 1990-91, Newfoundland and Labrador.

These data suggest that a pattern frequently identified in gender/evaluation research is at work: girls tend to do better on teacher-scored and set examinations than on standardized examinations, perhaps because of the "testing bias" factors earlier discussed. To be fair, it is also possible that these results also could be explained by claiming teachers "boost" girls' classroom marks, or perhaps bias their own examinations in such a way as to disadvantage males. While no firm conclusions can be drawn from this limited sample, it is grounds to carefully track results where similar data are available.

In other respects, the success rate data from Newfoundland/Labrador indicate only small differences (from 3% to 3.8%) with males outscoring females on 8 of 14 measurements. While these differences may seem marginal, in the highly-competitive world of post-secondary admission standards, small differences can be crucial. Further questions concerning success rates are raised by the following:

Students Writing Public Exams, 1990-91

COURSE	% FEMALE	% MALE
Biology 3201	91.3	89.6
Chemistry 3202	92.0	87.7
Advanced Math 3201	81.6	87.9
Academic Math	100.0	100.0
Geology 3203	91.2	87.1
Physics 3204	93.8	90.9
Environmental Science	88.5	80.0

Students writing public exams, by gender, expressed as a percentage of those eligible to write, selected subjects, 1990-91, Newfoundland and Labrador.

Not all students enroled complete each course and write the final examination. These figures suggest a gendered course attrition rate, with males being more likely than females to drop courses in all subjects except advanced mathematics. This would seem to suggest that by the conclusion of the course, a slightly larger proportion of "weaker" male students has left the course, presumably improving the remaining boys' averages. Girls' tenacity in other courses is markedly reversed when it comes to advanced mathematics, from which girls drop out disproportionately compared with either boys in this course or with their established pattern in other MST courses.

Prince Edward Island

Participation Rates: 88-89 - 90-91

	88-89		89-90		90-91	
COURSE	% F	% M	% F	% M	% F	% M
Math 621	53	47	54	46	52	48
Math 631	49	51	46	54	45	55
Math 651	60	40	38	62	22	78
Chemistry 611	48	52	42	58	49	51
Chemistry 621	51	49	55	45	54	46
Biology 621	52	48	61	39	60	40
Human biology 631	53	47	49	51	40	60
Physics 621	28	72	46	54	41	59

Participation rates by gender, expressed as a percentage of course enrolment, for 1988-89, 89-90 and 90-91, Prince Edward Island.

The data for Prince Edward Island report substantial participation differences by gender. In 1990-91, female enrolment exceeded male enrolment on 3 of 8 courses, in 1989-90 in 3 and in 88-89 in 5, with girls reducing their participation in human biology and mathematics 651. Among the eight courses during the three school years studied, there was a greater than 10% gender difference in participation 12 times out of a possible 24.

Success data were not supplied by the Ministry of Education, but enrolment in all courses, by gender, was provided. These additional figures suggest course-stereotyping by gender is not limited to MST subjects.

Course enrolment: 1990-91

COURSE	% OF STUDENTS		TOTAL ENROLMENT
	FEMALE	MALE	
English 551	18	82	46
French (core) 521	69	31	347
French Immersion	67	33	186
Law 521	74	26	122
Clothing 521	96	4	52
Child Development 521	95	5	177
Family Living 621	70	30	362
Music 621	61	39	89
Practical Science 451	20	80	78
World Geography 531	35	65	218
Advanced Politics	35	65	180
Business Typing II	86	14	111
Drafting	14	86	63
Electronics	9	91	64
Welding	2	98	56
Childcare	100	0	6

Participation by gender, expressed as a total percentage of course enrolment, for selected courses offered, and total enrolment for each course, 1990-91, Prince Edward Island.

The problem of equitable participation is not resolved by concluding other provinces and territories are experiencing similar patterns. It is reasonable to conclude that no student is forbidden from taking a gender non-traditional course, but it is apparent that prima facie equality of access to programs is not sufficient to ensure equality of outcomes. Established patterns will self-perpetuate without concerted efforts to interrupt them.

These data also provide an opportunity to reflect on the singularity of concern with girls' more frequent and profitable encounters with MST. Too often, related technical and vocational studies in non-traditional areas for women are overlooked in the schools' penchant for focusing on academic and post-secondary preparation. In addition, it raises the question why there is no parallel emphasis on boys pursuing subjects which would expand the boundaries of male studies. If reducing the effect gender has on course selection is the goal being pursued,

then encouraging males to study psychology, child development and aesthetics should be pursued as vigorously as enroling more girls in physics.

British Columbia

Participation, 1986-90

COURSE	% FEMALE			% MALE		
	86	88	90	86	88	90
Consumer Math	59	56	51	41	44	49
Trade Math	15	21	18	85	79	82
Statistics 12	43	43	47	57	57	53
Geometry 12	31	35	41	69	65	59
Algebra 12	45	45	46	55	55	54
Algebra 11	49	50	49	51	50	51
Computer 12	25	30	17	75	70	83
Computer 11	38	41	44	62	69	56
Sci-Tech 11	41	45	45	59	55	55
Physics 12	23	23	24	77	77	76
Physics 11	34	37	38	66	63	62
Geology 12	37	39	37	63	61	63
Chemistry 12	42	43	45	58	57	55
Chemistry 11	47	50	50	53	50	50
Biology 12	61	61	61	39	39	39
Biology 11	58	58	57	42	42	43

Participation rates, by gender, expressed as a percentage of course enrolment for selected courses, 1986, 1988, 1990, British Columbia.

The British Columbia Ministry of Education provided three years of data for two grade levels. Within sixteen courses over three reporting years (48 events), only on 12 occasions did female participation exceed male participation. The rate of girls' participation increased between 1986 and 1990 by more than three percentage points in only five courses, and it declined by more than this amount in two courses. For those courses offered at both the grade 11 and 12 levels, there was a marked decrease in participation in the more senior courses, except in biology:

Participation by Grade, 1990

COURSE	GRADE XI	GRADE XII
Algebra	49 %	46 %
Computer	44	17
Physics	38	24
Chemistry	50	45
Biology	57	61

Participation rates of girls, expressed as a percentage of course enrolment, selected courses, grades XI and XII, 1990, British Columbia.

This would suggest a willingness on the part of girls to attempt MST subjects, but a reluctance to persist in following years. Some believe that this tendency indicates boys' more intent focus on ensuring they have the necessary prerequisites for post-secondary programs; others see in this trend evidence of discouragement rather than disinterest. It is clear that it is necessary to encourage girls not only to enrol in the initial level of any course, but to continue their studies in subsequent years.

Quebec

The Report of the Government of Quebec, "Education Indicators for the Elementary and Secondary Levels", provides a variety of information, by gender, but little detailed course-by-course data. The 1991 report points out:

- *The disparity between females and males in general education results was 7% in favour of girls in 1975 and 14% by 1988.*
- *The college entrance rate for girls was 17 percentage points greater than for boys in 1990.*
- *In 1989-90, 28% of boys were "behind" in elementary school, compared with 18% of girls. ("Falling behind" is defined by the Ministry as not reaching secondary school by age 12.) Girls were proportionately less likely to have fallen behind in 89-90 than in 80-81.*
- *Average results on ministry-prepared secondary school examinations (June 1990) favoured boys by .7%; the success rate (achievement of 60% or greater) favoured boys by 2.9%.*

Additional participation and success data, by gender, were not made available.

The findings, however, suggest that within Quebec, girls' participation and success rates are comparatively high. These findings seem quite consistent with other reports which have found gender tendencies typifying the rest of Canada not to be entirely representative of Québec. For example, the study of adolescent girls, We're Here; Listen to Us found consistently higher self-esteem among Québec young women.[7]

Saskatchewan

Participation 1986-1990

COURSE	% F 86-87	% F 87-88	% F 88-89	% F 89-90
Science 10	49.8	48.9	49.1	49.8
Algebra 10	50.7	49.8	49.8	50.0
Math 10	43.1	41.2	50.0	43.1
Geo-Trig 10	48.5	48.4	49.0	49.9
Modern Biology 20	53.8	53.6	52.9	53.7
BSCS (Physics) 20	52.9	53.1	52.3	51.6
Algebra 20	50.9	51.6	50.3	50.3
Math 20	43.2	43.0	41.3	49.2
Geo-Trig 20	47.7	48.2	47.4	48.4
Physics 20	47.2	47.2	46.9	46.8
Chemistry 20	50.8	51.5	50.8	51.4
Modern Biology 30	57.6	55.3	57.5	56.8
BSCS (Physics) 30	55.5	55.4	55.8	55.0
Algebra 30	51.7	51.3	51.8	50.9
Math 30	50.9	50.9	44.2	46.6
Geo-Trig 30	47.7	48.7	48.9	48.6
Chemistry 30	51.5	51.1	51.4	51.7
Physics 30	43.4	44.2	44.5	45.1

Participation rates, for selected courses for three grade levels, expressed as a percentage of course enrolment, 1986-87 to 1989-90, Saskatchewan.

Saskatchewan data allow comparisons over a four year period across grade levels, and an analysis of participation and success rate trends. Over the four years reported for 18 courses, girls' participation rate was above 50% on 37 or just over half of the 72 cases examined. The difference in participation rates exceeded a

four percentage point spread on only 17 of these measures, seven of which occurred within the mathematics 10, 20 and 30 levels rather than in the more academically-directed mathematics courses of algebra and geometry-trigonometry.

A less significant drop in girls' participation rates from one grade to the next within each subject area is also evident. In fact, in five of the seven courses, girls' participation rates increased between the first and last year of study:

Participation, 1989-90

COURSE	GRADE 10	GRADE 11	GRADE 12
Algebra	50.0	50.3	50.9
Geo-Trig.	49.9	48.4	48.6
Math	43.1	49.2	46.6
Physics	---	46.8	45.1
BSCS Physics	---	51.6	55.0
Chemistry	---	51.4	51.7
Modern Biology	---	53.7	56.8

Participation rates of girls, expressed as a percentage of total course enrolment for three grade levels, selected courses, 1989-90, Saskatchewan.

Success rates were provided for each course for all four years at each of the three grade levels. The following is representative of these results:

Success, 1989-90

COURSE	% FEMALE	% MALE
Science 10	68.1	64.8
Algebra 10	67.9	63.9
Math 10	57.6	55.6
Geo-Trig 10	71.1	69.4
Modern Biology 20	68.6	64.5
BSCS (Physics) 20	69.6	66.1
Algebra 20	69.1	64.6
Math 20	58.5	58.5
Geo-Trig 20	73.1	70.2
Physics 20	71.5	68.6
Chemistry 20	70.4	67.7
Modern Biology 30	69.2	67.7
BSCS (Physics) 30	69.5	66.5
Algebra 30	68.7	67.3
Math 30	64.1	61.2
Geo-Trig 30	72.9	70.5
Chemistry 30	69.2	68.1
Physics 30	70.4	70.0

Average mark, by gender, for selected subjects, 1989-90, Saskatchewan.

In the case of Saskatchewan, girls' scores were better than or equal to those of boys in all 18 courses in 89-90. This apparent anomaly in both the key variables of girls' participation and success within this province is worthy of further study by those who would like to see their jurisdiction's figures move in a similar direction.

Nova Scotia

Participation, 1990-91

COURSE	% FEMALE	% MALE
Math 441	19.33	21.54
Math 541	1.44	2.03
Biology 441	56.27	40.27
Biology 541	3.83	3.44
Chemistry 441	34.27	30.15
Chemistry 541	2.28	3.23
Physics 441	15.48	25.00
Physics 541	.70	1.79

Enrolment, by gender, expressed as a percentage of grade enrolment by gender, 1990-91, Nova Scotia. [i.e. in 1990-91 19.33% of girls enroled in grade XII were enroled in Math 441.]

The Nova Scotia Department of Education provided course enrolments, by gender, in a unique way which tends to reduce the magnitude of gender differences. Since total enrolment in grade twelve in Nova Scotia is distributed almost equally (49.7% male, 50.3% female), the figures can be compared quite directly in a more familiar way.

Participation, 1990-91

COURSE	NUMBER FEMALE	NUMBER MALE	PERCENT FEMALE	PERCENT MALE
Math 441	1126	1239	47.6	52.4
Math 541	84	117	41.8	58.2
Biology 441	3278	2317	58.5	41.5
Biology 541	223	198	47.0	53.0
Chemistry 441	1996	1735	53.5	46.5
Chemistry 541	133	186	41.6	58.4
Physics 441	1438	902	38.6	61.4
Physics 541	41	103	28.5	71.5

Participation rate, by numbers and percentage of course enrolment, by gender, in selected courses at the grade XII level, 1990-91, Nova Scotia.

Of particular interest is the increased gender gap evident at the 500, or "honours" course level. Even in Chemistry and Biology, where female participation at the 400 level was greater than that of males, the trend is quite markedly reversed within the advanced courses.

This finding points to the need to examine how the gifted and academically talented are identified and encouraged. Prevailing assumptions about the behaviourial characteristics of the gifted may bias both teacher and parent perceptions. Most "checklists" of tendencies associated with giftedness suggest early verbal ability, curiosity in active play, individualism, non-conformity, etc. are indicators of unusual intelligence. Perhaps it is easier to note a highly-verbal boy because he is somewhat atypical of his peers, while many girls, including those who are not gifted, are highly verbal in a way that is taken for granted. Through gender socialization, girls have been found to ask for help more often than boys (even when they can perform a task independently), and tend to be rewarded for compliant and conforming behaviours. Thus, becoming a "good girl" can be antithetical to being seen as a "smart girl". Numerous studies have concluded that girls are under-identified as gifted students when subjective assessments are used.[8]

Self-identification of academic ability is also a gendered construct. According to the Nova Scotia Department of Education, students register in the "honours" 500-level program through self-selection. A substantial part of each course is devoted to independent study which requires a student to work on an individualized project, often away from the school. Since it is known girls tend to prefer cooperative and interactive experiences to independent and isolated work, and also tend to underestimate their competency to perform unfamiliar tasks well, their reluctance to choose off-site, self-directed study is predictable.

Many students of both sexes find wearing the label "advanced" or "gifted" a most uncomfortable experience. For girls in particular, who tend more than boys to draw their self-esteem from connection with and acceptance by peers, to be gifted may seem to be cursed, and to be doubly cursed if one is gifted not in the more female-friendly domains of languages or aesthetics but in the world of mathematics and sciences. To be seen as a science whiz would be more frightening than complementary for many young women, a guarantee that one would be labelled an outsider.

According to the Department of Education, recent work on the Nova Scotia Achievement Tests indicate a difference in performance by gender:

- *In science, level 9 boys outperformed girls to a statistically significant degree on 14 of the 75 questions, while girls outperformed boys on 2 questions.*
- *At level 12, the difference was more pronounced, with boys outperforming girls on 24 of the 75 questions. Level 12 girls outperformed boys on 2 questions.*
- *In mathematics, level 9 boys outperformed girls in 18 of the 100 questions, with girls outperforming boys in only 1 question.*
- *Similarly, in level 12 (mathematics), boys outperformed girls in 36 of the 110 questions, with girls outperforming boys in only two questions.*[9]

With outcomes such as these, it is clear that participation alone does not guarantee equality of results, at least as results are currently measured. The data above were accompanied by the note that the Department was "very aware that these descriptive results may be indicative of either differences in true performance or differences due to test bias or both, and (we) are investigating the results further." While such awareness on the part of Ministries may be common, only Nova Scotia volunteered this kind of statement.

Ontario

Participation, 1990-91

GRADE	COURSE	% FEMALE	% MALE
Grade 11	Mathematics	51.8	48.2
	Math-applied	46.4	53.6
	Biology	58.9	41.1
	Chemistry	49.2	50.8
Grade 12	Mathematics	50.4	49.6
	Math-applied	45.8	54.2
	Enviro-science	45.8	54.2
	Physics	37.2	62.8
OAC	Mathematics	41.4	58.6
	Calculus	45.6	54.4
	Math Finite	46.0	34.0
	Biology	59.8	40.2
	Chemistry	45.7	54.3
	Physics	34.4	63.6

Participation rates by gender, expressed as a percentage (f:m) of total course enrolment, selected courses, 1990-91, Ontario.

Within these three grade levels, girls' participation rate exceeded that of boys in biology (grades 11 and OAC) and mathematics (at grades 11 and 12). There is evidence of attrition of female students between the first and final years for all courses except biology. However, although the smallest comparable percentage of girls register in grade 12 physics, their "persistence rate" to the OAC level is relatively strong.

At the OAC level, the gender imbalance in all courses reaches its peak, with a minimum spread of 8.6 percentage points (chemistry) to a maximum of 29.2 points (physics).

Success rate data were supplied for all subjects and levels, along with a detailed frequency distribution. Selected courses and levels of achievement have been used to consider "success" in a more exact light.

Success, 1990-91

GRADE	COURSE	55-59 % F vs M		75-79 % F vs M		90-94 % F vs M		95-100% F vs M	
OAC	Math	5.2	6.3	11.8	11.5	11.3	10.5	5.3	6.2
	Calculus	7.3	7.1	10.9	10.3	8.7	5.5	4.1	5.7
	Math-finite	7.8	7.6	11.5	10.7	8.2	10.2	4.0	6.0
	Biology	7.3	8.2	12.9	12.5	5.7	6.2	1.5	1.8
	Chemistry	6.5	7.6	13.6	12.8	6.3	7.6	1.8	2.5
	Physics	5.7	7.3	14.2	12.6	7.9	8.1	2.3	3.0

Success rates, by gender, expressed as the percentage scoring within selected ranges, selected OAC courses, 1990-91, Ontario.
(i.e 5.2% of all female students scoring above 50% in OAC math received marks between 55% and 59%.)

The pattern suggested by this table indicates some trends which should be tracked carefully. Males were more likely than females to pass with lower (55-59) marks in four of the six courses, but females were consistently more likely to be in the slightly-above-average range (75-79). Among very high achieving students (95-100), males were quite strongly favoured in all six courses, as they were in four of the six courses within the 90-94 range.

These results should be read alongside the average marks, by gender, for the same courses:

OAC COURSE	Females	Males
Mathematics	75.6%	74.8%
Calculus	73.0	73.6
Math-Finite	72.3	73.7
Biology	72.2	71.9
Chemistry	72.8	72.9
Physics	74.0	73.3

Average marks, by gender, for selected OAC courses, 1990-91, Ontario.

When average marks are compared, females and males each show greater success in three courses. Notably, female students' greatest numerical advantage would appear to be in mathematics, closely followed by physics, both in terms of raw scores and in the relationship of their marks with the scores of boys. Given physics is the course with the lowest female enrolment, the findings are somewhat ironic. Put together with girls' relatively low attrition rate between the first and second year of physics, it would suggest that attracting girls to enrol in this subject is a greater challenge than ensuring they are sufficiently successful to continue.

The "sweep" of very high MST scores by males is not an uncommon finding, but this does not mean its causes are taken for granted, as the next section points out.

5.3 Is it "biological"?

These jurisdictional results suggest that girls' MST participation at the secondary level, while lagging somewhat behind that of males, is inadequate as the sole explanation of women's reluctance to pursue MST-related careers and post-secondary training in other than selected disciplines. The success rate data is somewhat contradictory, but it is safe to conclude that many more young women are eligible for MST studies at the post-secondary level than choose this option. While there is considerable work to be done in elementary and secondary schools, producing eligible MST female students in substantial numbers does not seem to break down at this level. Neither eligibility nor capability, however, appears to be sufficient to transcend the gendered reluctance to make a career within the less traditional fields of MST.

Conjecture and analysis which would help to explain girls' and women's participation and success rates in MST can be found throughout this document. However, one last set of theories pointing to innate lesser ability (and, therefore, less interest and enthusiasm) among females should be explored.

There are those who believe that the representative male and female brain differ sufficiently from each other that broad gender-related skills and tendencies, such as stronger verbal skills in females and stronger spatial skills in males, can be explained physiologically. If this is true, convoluted sociological interpretations of difference are not required. The research evidence on gender-specific biological predestination, by and large, is contradictory; uncontaminated research is difficult to find since the study of living brains can only take place with individuals socialized by their culture, and non-living brains are disassociated from human action.[10] At the same time, there is no doubt that the next few years will record enormous leaps in understanding brain function and, inevitably, brain differences.

For some the very thought of conducting and discussing such research is threatening; reports of such studies have evoked strong reaction and they have been condemned as comparable to research "proving" racial superiority. While there is danger in using research to justify the social structures which perpetuate and accentuate gender inequity, it is worth remembering that different need not necessarily mean inferior. Given the nature of our culture, however, caution is certainly appropriate: there is a great deal of evidence that those skills and characteristics associated with males tend to be more highly valued than those associated with females. The danger is thus not to be found in differences themselves, but in the systemic over-valuing of "masculine" characteristics.

Whatever gender differences may be found to exist in brain structure, differences of other kinds within each gender appear to be far more significant factors in predicting MST success. Socioeconomic levels, for example, are widely recognized predictors of school success, but in mathematics and science high socio-economic status is a stronger predictor for males than females. Girls who see themselves as competitive are likely to enjoy mathematics and science, and girls who reject traditional gender roles have higher mathematic scores than girls who have more stereotyped perspectives. Boys see mathematics as more "male" than girls, but those girls who agree tend to have lower marks than girls who see mathematics as gender-neutral.[11] The structure of the brain may not be in our control, but the incidence and impact of each of these far more important indicators can be altered if schools choose to make a difference.

Decoding the Data: Part II

Decoding the Data

Part II

6.1 The Post-Secondary Experience

> *"Carleton University was to alert students today of death threats received last week and an earlier bizarre theft from academic records of the photographs of 22 female students. "We don't believe the two incidents are related", Pat O'Brien, Carleton's director of information services, said Monday. "Our feeling is that the risk has been minimized." Still O'Brien said posters were to go up on campus today publicizing the incidents, which are connected to the Herzberg physics building. The poster campaign is meant to dispel rumours that circulated Monday among some students."*[1]

While it is clear that the participation and success rates of girls in MST at the secondary level prevent exactly equal numbers of males and females from entering post-secondary MST studies, it is obvious that factors other than pre-requisites influence post-secondary decisions and, ultimately, career choices.

Female students comprise an ever-greater proportion of students in both university and non-university studies, and they are a minority only in post-graduate studies. Enrolments by field of study, however, illustrate distinct gender patterns, in selected disciplines.

Community college full-time female enrolment, Canada, 1988-89

Humanities	70.0%
Arts	57.7
Business, Commerce	61.9
Engineering, Applied Science	15.5
Health Services	83.7
National Sciences, Primary Industries	31.1
Social Science, Services	71.5

Statistics Canada, Education in Canada, vol. 81-229.[2]

Similar patterns are evident in undergraduate university programs, with women most likely to be enroled in nursing, education and fine arts, and least likely to be found in mathematics/sciences and engineering/applied sciences.

University full-time female enrolment, Canada, 1988-89

Agriculture and Biological Sciences	56.0%
All Health	66.8
Arts and Science (General)	54.5
Dental	36.8
Education General	73.3
Engineering and Applied Sciences	14.2
Fine Arts	61.0
Math and Physical Sciences	27.8
Medical	45.6
Nursing	94.5
Pharmacy	63.7
Physical Education	48.2
Social Sciences	51.6

Statistics Canada, Education in Canada, Vol. 81-229.[3]

It would appear that patterns which are evident in high school (and which probably have earlier roots) have reached their culmination by graduate school. Women who have persisted at the undergraduate level do not pursue post-graduate studies in non-traditional fields in numbers proportionate to their male counterparts, and therefore tend to compete with more limited credentials in traditionally male fields.

6.2 Beyond Numbers

Participation rates, of course, fall short of identifying the experience of female students. Holland and Eisenhart[4] warn us that these numbers mask the perpetuation of bias; women who "participate" are not necessarily on an equal footing. Their research concludes female students' academic contributions and achievements are undervalued; that their aspirations lack encouragement and that their lives at university become preoccupied with the only apparent means to

achievement and success: romantic relationships. The researchers concluded college actually diverts women from their goals. They found that young women tended to be more academically and career-oriented when they entered college than part-way through; those who persisted as "serious" students could do so only by surviving institutional and peer discouragement. From their sample, in fact, those who entered university with the highest academic aspirations were the most likely to drop out or radically alter their career plans. Those with more instrumental "I can play the game" orientations were more likely to persevere, but at the cost of becoming cynical. According to the authors, female students turned in frustration to relationships as their only profitable and reliable source of self-esteem. Within student peer groups, the existing gender hierarchy was recognized but unchallenged, even actively perpetuated. It would seem that with their dreams of "respected career" receding, it was too much to ask young women to engage in challenging the fall-back myth of happily-ever-after.

Gilbert and Pomfret in their 1991 analysis of gender-tracking in Canadian University programs do not deal with the ascendency of romance in the wake of frustrated academic and career goals, but they report similar patterns of decreasing engagement among high-achieving female undergraduates.[5] The authors conclude that women can do science, but choose not to, partly in response to the "prejudices of patriarchy", partly because advanced academic training is inconsistent with competing responsibilities, and partly because the content of science and the practices of scientific work and teaching are incompatible with women's values. The authors associate science with the "justice and rights" orientation more common among males than with the "response and care" orientation more typical of women.[6]

Through their survey of University of Guelph students, the authors concluded that "gender is an important and pervasive factor in student expectations, progress, program selection and satisfaction. In particular, women display greater levels of motivation to attain undergraduate degrees, perform better academically in high school, and initially in university, than men, yet have lower estimates of their academic ability and potential for graduate study than do men."[7]

The authors compared female and male students who were awarded Canada Scholar status in "science" and "non-science" programs. They found:

- *Women in both science and non-science programs exhibited a greater valuing than their male peers of relationships, caring for others and working in a supportive environment.*
- *Male students in both science and non-science programs rated themselves*

higher on cognitive abilities than did female students, the reverse was found for self-management and interpersonal abilities. This pattern was especially strong among science students.

- *Female and male students held differing opinions regarding the necessary traits to be successful in the sciences, with females more likely to rate items such as "ability to work independently" as more important than males.*
- *When compared with female non-science students, female science students saw "the ability to help others" as a trait much less fundamental to their work.*
- *When asked to indicate the importance of "responding to others' needs" as a factor influencing their choice of a university program, both gender differences and science/non-science differences were strong. Meeting others' needs was rated "very high" by 34% and 15% of the female non-science and science students respectively, and by 13% and 5% of the male non-science and science students respectively.*
- *Female science students anticipated greater work-family conflicts in the practice of their careers than women in the non-science area.*
- *Female science students were more likely than their male counterparts to regard academic stress and personal difficulties as negative aspects of university life, and they were much more likely than males to value "personal growth" as a desirable outcome of university studies.*
- *High-achieving female science students were much more likely than males to cite high school teachers as influencing their decisions to major in science. Females rated social support from family, friends and other significant adults as more influential than did males.*
- *Females described "an inquiring mind" as a prerequisite of science success more often than did males.*
- *Having "very good" high school marks, and expecting high marks at university influenced females more than males to enrol in science courses.*
- *Male science students who left high school with B+ and A grades were more likely than comparable females to maintain or improve their grades at university. However, early-semester drops experienced by females were reduced gradually and the gender gap in marks narrowed over time.*
- *Female science students who dropped out or transferred from science programs were those who scored more highly on the "response and care orientation" scale than females who persisted in science studies.*
- *Women with high self-competency assessments were more likely to leave science studies than other female students. They appeared to be acting on their sense of a poor "fit" between themselves and science.*

The conclusions of this very useful study came in large part from the students themselves. Although the context is post-secondary, these recommendations can be translated into elementary and secondary classrooms and, indeed, should not be limited to MST classrooms. They include the need for hands-on experience, small classes, personal attention, caring and adaptable teachers, more female

instructors, more breadth and flexibility and less memorization. The students believed, overwhelmingly, that the person at the front of the room could make a difference.

6.3 The case of engineering

> *" On any usual Monday morning, an air of lassitude hangs over the three-storey Victorian house on St. George Street, home of The Varsity, the University of Toronto's student newspaper. The frenzy of the weekend, when the last story is filed and sent to the printer, is over. But, as Naomi Klein, the 22-year-old English and philosophy major who is now the paper's editor, recalls, April 6, 1992, was not any usual Monday. When Klein entered the newspaper offices that morning, she found a chaos of strewn paper, overturned furniture and doors removed from their hinges. Enraged at an article on women's sexuality that had appeared in The Varsity, vandals had raided the publication's premises the night before. On a small, second-floor roof, they tethered a 13-foot phallic symbol made of chicken wire, newspaper and green garbage bags. Nearby, they defaced the front the building with an orange, spray-painted sign that read: "Try this zucchini on for size." In the computer room, the intruders left a personal and sexually threatening message to Klein, whose name had appeared as editor on the offending article. On the walls, the vandals also left their signature - the initials BFC.*
>
> *Until it was banned from the U of T campus several years ago, the Brute Force Committee, an ad hoc club that drew its members from the ranks of senior engineering students, was well known for its boorish behaviour. Among its many questionable activities, BFC assumed responsibility for humiliating and intimidating new students during freshman initiation ceremonies. The administrators of U of T's engineering faculty insist that BFC no longer exists. But that's not the opinion of others-faculty members and students who have read the writing they see on walls. Like Klein, who is now afraid to work alone at the newspaper offices at night, they believe that the engineers' committee is still very much alive." [Boys Club, Globe and Mail, Aug. 21/92, Shona McKay]*

The best known Canadian analysis of women, engineering and related issues is provided by the aptly-named More Than Just Numbers, the report of the Canadian

Committee on Women and Engineering.[8] While this report is profession-specific, its conclusions should be heeded and applied to all disciplines.

The report begins by noting that more women are becoming engineers, with the percentage of registered professional engineers in Canada who are women increasing from one half of 1% in 1980 to 3.2% in 1990. However, between 1975 and 1989, much more significant gains were made by women in other traditionally male-dominated professions: the percentage of degrees granted to female lawyers increased from 21% to 48%, to female doctors of medicine from 24% to 45%, and to female engineers from 3% to 13%.

Somewhat predictably, the selling of the need to increase women's participation in engineering has rested on the now-familiar economic imperative arguments. The report quotes Bernard Valcourt, Minister of Employment and Immigration:

> *"How can Canadians tolerate this level of exclusion of women and their talents? We've been literally robbing Canada of 50 percent of its potential. Without the full participation of women who have developed their full potential, Canada will not be able to compete against other developed nations."* [p4]

When other justifications are introduced, they are not left to stand on their own, but buffeted by bottom line advantages. Leon Sorenson of Petro-Canada is quoted in the report as supporting the Committee's initiative:

> *"The decision to make changes is not only a moral decision, but a necessary business decision."* [p5]

Again, change is justified not because of the benefits it may bring women, but because of benefits either to productivity or to the status of the profession:

> *"It's the profession of engineering that suffers if we do not have a supply of women."* [Janet Halliwell, Science Council of Canada] [p5]

> *"No major profession can be satisfied with our low percentage of women, a fact which may question our status as a major profession."* [Patrick Quinn, P. Eng.] [p5]

"... with their ability to communicate and establish personal relationships, with their rational and emotional management skills, with their professional awareness and proverbial sense of responsibility, women have much to give to the world of business and industry." [Charles Perrault, Shroeder Investment] [p5]

The committee's selection of these testimonials may prove to be strategic positioning, but they are nonetheless rather sad examples of the arguments which today must be marshalled in the name of equity, particularly when one takes a closer look at the forces which characterize the experience of female engineers and engineering students. The report of the Committee gives voice to women engineers, many of whom reported isolation, anger, lack of respect, sexual harassment, and limited career advancement opportunities. Some told harrowing tales, some denied that their gender had created any problems (or, more accurately, that others had created problems for them because of their gender). Adaptation to prevailing values, no matter how distasteful, working twice as hard to be thought half as good and developing a thick skin were seen as necessary accommodations to practising a satisfying - but male - profession.

One has the sense that the Committee set out to find out how to attract more women to the profession of which they were a part. However, through the testimony of students and graduates, the Committee came to the conclusion that only if the profession itself experienced a transformation could they feel justified in persuading girls and young women to pursue careers in engineering (without reservation).

It is this conclusion which requires more of our attention. Perhaps it is unconscionable to promote to young women any career path which systematically disempowers them. At the very least, we need to be fair, forthright and honest in putting forward the culture and values associated with various kinds of work and work settings. Young women are not naive; they already demonstrate through their enrolment patterns that enjoying the content of a subject is not sufficient inducement to transcend its attendant drawbacks.

Of course, it is equally unfair to stereotype or malign a particular profession as being singularly sexist in a world which provides ample examples of sexism in all walks of life. No doubt there are many engineers and engineering firms more egalitarian than some teachers and their staffrooms, and it could be argued that at least in engineering there appears to be a sustained recognition within the leadership of the profession that gender inequity exists. When it becomes more acceptable to deal openly with issues of gender in schools and society, we will be

much better able to deal with issues of equity and discrimination in ways that allow individuals and systems to change and not just cope with pervasive bias. If these issues continue to be evaded, it is inappropriate to cast stones at others who similarly are reluctant to take responsibility for changing their professional cultures.

Decoding the Data: Part III

Decoding the Data

Part III

7.1 Teachers of MST

While few of those commenting on MST issues neglect teachers in their assessment of how to turn around the gender-tracking of students, there are discernable differences in how the "problem" of teachers is approached. Critics debate whether teachers' deficiencies are factors of qualifications and professional competence, attitude or type. For example:

- ***On qualifications and competence***:, *"A great deal of mathematics is being taught in Canadian schools by teachers who are ill-equipped for that task."*[1]
- ***On type***: *"Although some jurisdictions are addressing this issue, there is little exposure in Canadian schools to female role models in the sciences."*[2]
- ***On attitude***: *"My grade 11 mathematics teacher was also the coach of the boys' hockey team. He openly favoured the guys in the class and he saw them as his buddies. My female classmates and I felt excluded and we were very intimidated to ask questions or seek help. I felt as though I was interrupting their locker room talk. We were all called by our last names. It was not very encouraging to be asked "What do you want Lawrence?" when I needed help with a mathematic problem. The guys used to laugh if girls got a question wrong. The teacher certainly did not discourage their behaviour."[student's journal entry]*[3]

There is little question that there is some truth in each of these statements, but often little appreciation of the complexity within each aspect of the problem. Some of the questions which need to be addressed include:

On qualifications and competence

Given it is outside the jurisdiction of the profession to determine the quantity, quality and nature of professional teacher preparation, how can the profession influence "adequate" preparation? Given the apparent conflict between the values of those most likely to be attracted to teaching and those attracted to science, how can the role of "science teacher" hold fewer internal contradictions? Given the disappearance of significant opportunities for professional development, how can

practising teachers acquire the methodological and pedagogical skills of teaching MST while practising their profession? Given increased competition for places in elementary/secondary education and increased recruiting by MST faculties, how can education compete for MST-minded individuals?

While these questions are valid, there is an overall tendency within the 'qualifications' argument to conclude that advanced subject-specific knowledge is a prerequisite to the effective teaching of science, and that knowledge of content rather than the many other qualities of an effective teacher is the key element in improving student participation and achievement.

Without negating the need for the content capability of teachers in all fields, teaching is more than the transfer of information. There is evidence that mathematics/science teachers fail to implement many of the teaching strategies employed by their colleagues in other areas. King and Peart (1992) found that at the high school level, teachers of mathematics and sciences were more likely than teachers of any other subject or grade level to rely on "lecture/presentation/demonstration" as their preferred instructional strategy and the least likely of all teachers to use small group work.[4] It would appear that there are strong cultural and professional norms at play which would not be broken down by taking another class or two in advanced mathematics and physics.

While it is possible MST teachers have not been exposed to professional education at either pre-service or inservice levels which challenges the "lecture and take notes" approach to instruction, this seems rather improbable. A more convincing case can be made for the existence of a MST paradigm which places knowledge in the hands of the teacher and text, and casts the student as the passive recipient of information. Until this paradigm shifts, building greater repositories of content in MST teachers will not change students' lack of engagement in the creation of meaning.

On type

> *"Less than 20% of grade ten mathematics teachers are women, and less than 20% of grade 4 mathematics teachers are male. These imbalances seem not to have changed substantially since previous assessments, and this is an area of considerable concern."*[5]

Virtually all who comment on gender and MST lament the lack of female role models teaching in these areas at senior levels. While gender-typing of teaching

assignment is not limited to MST subjects, its influence is thought to be particularly strong because of the reported influence of teachers on individual career choice for women who pursue MST in post-secondary studies.[6]

As the CTF publication Progress Revisited points out, education is an internally sex-segregated profession with sex-predictable differences to be found at grade level taught, subject area and hierarchical positioning.[7]

The percentage of teachers who are female is increasing, particularly at the elementary level, in all jurisdictions.[8] There has been little detailed analysis of the forces pushing this trend, but it invites speculation that as the professional autonomy of teachers declines as the challenges and expectations of schools increase, as public criticism is stirred and monetary rewards stagnate, fewer men believe the compensations of teaching are worth the sacrifices. Women teachers, who are more likely than their male colleagues to feel rewarded by the intrinsic interpersonal satisfactions of teaching children,[9] are still attracted to teaching in large numbers. However, as the Gilbert and Pomfret study points out, this orientation to service is not typical of undergraduate science students, although it is more typical of females within this group.[10]

Many fewer women than men have authority in the hiring and directing teachers to teaching assignments. Some attempts at "balance" have been clumsy; women with inadequate preparation and experience who find themselves assigned to science departments may resent being "set up to fail", and males who consider themselves bypassed may harbour resentment. Elementary school teachers, nearly 75% of whom are women, do not appear to be discouraging girls from liking MST topics, if American studies reflect Canada experience. Each of these problems is a subset of the "gender-balance" question, and each requires consideration in the development and implementation of reforms.

Concluding that only female teachers can influence young women positively, however, is an unfair assumption. It would appear that there are (at least) two issues to be resolved from the perspective of young women. The first is to conclude "women can do it", and here the case for female role models is very strong. The second step requires a young woman to conclude "I can do it too". The leap from the first to the second conclusion is not achieved automatically through exposure to female MST teachers, nor is it true that male teachers cannot supply the validation and encouragement required by individual students. It is probable that in most cases the influence of girls' teachers (of either sex) is insufficient to transcend other influences if those are in opposition to non-stereotypical choices.

While the extent of teacher influence on career choice is debatable (and, some would argue, perhaps the role itself is inappropriate), Gilbert and Pomfret found teachers were more likely to be named as playing "an important role" in the decision-making process by female students, and in particular by high-achieving female students:

> *"With respect to people who played an important role in affecting their decision to major in science, females attribute more importance than males to mothers, fathers, high school teachers, and high school guidance counsellors. High achieving women science students were much more likely than men to cite high school teachers as influencing their decision to major in science."*[11]

In this study, the sex of the teacher would appear to be a significant, but not necessarily the determining variable:

> *"More high-achieving women (15%) than men in science had mainly women role models. However, 80% of the men had mainly male role models whereas only 39% of the women did."*[12]

There are several ways to interpret this finding, including an invitation to speculate on the reluctance of young males to think of bestowing the title of "role model" on the adult women in their lives. And while young women were more likely than young men to cite female role models, 46% said their influences came "equally" from men and women.

While there are many nuances to this discussion of gender and influence, it is absolutely certain that the power to discourage is available to both genders within and outside schools. The leap between "women can do it" and "I can do it" appears to be fraught with problems. Teachers of either sex can make this journey even more difficult.

On attitude

The question is not whether schools and teachers are more sexist than society, but rather how (and whether) sexism can be minimized in schools obligated to serve and intended to reflect societal values.

While this statement can be read as a conditional excuse for schools to perpetuate sexism, it is intended rather to underscore the need for congruency among all agents influencing the quality of education of girls and women, from Ministries of Education through media advertisers. It is unlikely that any component of the system, including teachers, could independently overthrow the rules of patriarchy. This being said, there can be enormous tolerance within the profession for private, if not public, expressions of hostility to the goals of equity (and towards those who advance them) and ever greater tolerance for silence among all the components of education systems regarding issues of gender and schooling.

These attitudes exist coincidently with the extraordinary efforts of many teachers to make their schools equitable. The acceptance of both contradictory stances might be seen as evidence of academic freedom, but relegating a profession's stance on equity to the status of "a matter of opinion" is an extraordinary indictment of the entire education system. While there must continue to be debate on the most appropriate path to equity, the debate must be informed in a way it cannot be if "the right to not know" is not challenged. Regrettably, the right to choose to be oblivious to the kind of data contained in this report is condoned at all levels; it is not unreasonable that minimal professional requirements incorporate an expectation of a basic understanding of gender issues. This is the key attitudinal change: an acceptance of the professional responsibility not only to acknowledge the obvious but to seek to understand "the presence of absence" of the dialogue on gender equity.

Conclusions and Recommendations

Conclusions and Recommendations

This paper has touched on scores of considerations which should inform plans and projects intended to improve the participation and success rates of girls in mathematics, science and technology studies.

The ten conclusions drawn from the paper have been distilled from many other recommendations which could have been made. The actions implied by these conclusions still constitute a very tall order, but the exclusion of any of these elements from a comprehensive plan dooms any hope of sustained, long-term change. While not every initiative will address all the goals from which these conclusions flow, every initiative should consider how as many elements as possible can be integrated within it. The multiple complementary changes required within and outside schools will require the same attention afforded to other major "planned change" initiatives.

1. Garnering support for "girls-and-MST" initiatives should not be undertaken or argued solely on the basis of nationalistic economic fortunes. This kind of limited justification precludes looking more inclusively at systemic gender dynamics, and it invites others to discard less economically-advantageous reforms equally important to the equity of women.

2. The biases of "science" need to be challenged within and outside the discipline. The role of MST in shaping our economic, environmental and technological futures is too vital to everyone to be neglected by those with new ways of shaping human priorities.

3. The reality of the gendered-biased classroom must be recognized by all those who have any role or interest in what happens in schools. Achieving a new vision requires recognition of the power of the old.

4. Schools must work to invent "girl-friendly" curricula and cultures which go well beyond avoiding overt gender bias. Lack of awareness must cease to be used or condoned as an excuse for perpetuating disadvantage.

5. The responsibility for the development of gender-equitable education must be shared between women and men inside and outside schools. The goals of change must not be limited to the attitudes and behaviours of young women.

6. While there is great variation in the quality of girls' lives, there must be recognition of the impact of "living as a girl" imbedded in existing resources to identify strategies and interventions known to be effective. This requires relinquishing the right to evade the issues of greatest importance to girls and young women, and in particular the recognition that girls are victimized collectively by male violence in many forms.

7. A greater amount of detailed and specific data on gender, participation and success rates must be collected and, ideally, reported in similar ways. Gender equity must become part of educational accountability at every level, which would require individual schools to track these outcomes as well.

8. Research which searches for gender-bias in testing, and the reformulation of biased tests must become part of all testing and accountability initiatives.

9. The transition of girls to post-secondary MST education appears to be problematic from a number of perspectives. Girls need a better idea of "what to expect", colleges and universities must cease to expect female students to do all the accommodating.

10. A profession which maintains an internal gender-imbalace of power, roles and responsibilities is unlikely to foster students free from gender stereotypes. No part of the profession can exempt itself from implementing what is known about effective teaching and learning.

There is a momentum building to deal in an holistic way with the issues raised in this paper. The resources are growing along with the expectation that schools can and must change. It is for the teachers and students who will create and benefit from these changes that The BETTER Idea Book has been written.

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Background Materials and Curriculum Resources to Encourage Females Into the Fields of Mathematics, Science and Technology: An Annotated Bibliography

Prepared for the Ontario Women's Directorate

By Beth McAuley

March 1990
Revised November 1992

First produced by and also available from the
Ontario Women's Directorate
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The Ontario-Women's Directorate is pleased to thank the following people who assisted in the research phase of this bibliography:

Marilyn Dickson, Federation of Women Teachers' Associations of Ontario;
Kamala Jean Gopie and Betty Lamont, North York Board of Education;
Gila Hanna, MECA, Ontario Institute for Studies in Education;
Sue Lewis, then at Equals, Lawrence Hall of Science, Berkeley CA;
Lorna Wiggan, Faculty of Education, York University;
and the librarians and staff at F.W.T.A.O., North York Board of Education, Toronto Board of Education and O.I.S.E.

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General References

(Distributor) (Location(s)/Call Number(s))

Baker, Maureen.

"What will Tomorrow Bring?.... *"A Study of the Aspirations of Adolescent Women.* Ottawa: Canadian Advisory Council on the Status of Women, 1985. 176 pgs. This research study indicates that female adolescents are not being adequately prepared for a changing world. Effective guidance and counselling services may be needed to encourage more awareness of the technological changes that will affect their career choice. Of special interest is the chapter on Education which looks at educational aspirations, course selection, extracurricular activities and the barriers faced in pursuit of educational goals.

(CCSD) (OISE/305.40971 B168W)

Baker, Maureen.

"Quand je pense à demain..." *Une étude sur les aspirations des adolescentes.* Ottawa: Conseil consultatif canadien de la situation de la femme, 1985.195 pgs. This is the French edition of the research study cited above.

(CCSD) (OISE/Women's Resource Centre)

Berthelot, Michèle, and Nicole Coquatrix.

Au delà des mythes: les hauts et les bas des travailleuses non traditionnelles: Faits Saillants. Recherche sur les conditions de travail et de formation de jeunes femmes exerçant un emploi non traditionnel. (Diplômées de l'enseignement secondaire, collégial et universitaire.) Gouvernement du Québec, ministère de l'Éducation, coordination à la condition féminine, 1989. 39 pgs. This research report looks at women working in three levels of non-traditional occupations: these include young women with secondary diplomas employed as butchers and dental technicians; collegiate graduates working as architectural technicians and physical science engineers; and university graduates employed as mathematicians, dentists and engineers. The research analyzes working conditions, salaries, sexual harassment, sexist stereotyping, the gains and rewards of such work, and the difficulties in attaining these occupations. Major influences include parental attitudes, father's occupation and teacher encouragement and support. The authors recommend the ongoing improvement of orientating young women towards non-traditional careers and the important roles schools and teaching staff must play in helping them achieve their goals.

(GG) (OWD Resource Centre)

Blackstone, Pamela, ed.

Breaking the Barriers: Encouraging Girls in Math, Science, and Computers. Software and Information Kit. Victoria, B.C.: Victoria Status of Women Action Group in Association with Software Training Associates, 1989. This kit, intended

for girls in grades 3 through 7, consists of a software disk for students and print materials for teachers. It is divided into five sections: l) a multiple choice Herstory Quiz (on diskette) — a game focusing on Canadian women's achievements in math and science with reference materials for teachers; 2) a 73-page report which includes reviews of recent research and recommended intervention 3 strategies; 3) a 93-page listing of educational resources (software, curriculum aids, etc.) ; 4) activities to augment classroom lessons and enhance logic and problem-solving skills; and 5) a bibliography. Software available for IBM PC/XT, Apple II Series, Macintosh.
(STA)

Canadian Committee on Women in Engineering.

More Than Just Numbers: Report of the Canadian Committee on Women in Engineering/Elles font une différence, Rapport du Comité Canadien des femmes en ingénierie. Fredericton, NB: Faculty of Engineering, University of New Brunswick, April 1992. 0-9696015-1-4. English 148 pgs./French 176 pgs. Spiral bound. The recommendations made in this publication are not only to attract greater numbers of women into the profession, but also to ensure that the learning and working environments welcome, support and appreciate women engineering students and engineers. The report is divided into four main sections, each addressing the responsibility of a particular sector: 1) the socialization and education of women in the pre-university years - parental and social influences, the role of the educator; 2) how universities and faculties can create women-friendly environments; 3) how the employer can change the corporate culture to ensure support for women in non-traditional roles; 4) the roles professional associations can play in promoting engineering as a viable career for women. Each chapter within the sections includes recommendations and schedules for successfully implementing them. Throughout the report, anonymous personal accounts of women engineering students and engineers highlight the difficulties and successes of working in the profession. Appendices. Bibliography. List of initiatives and recommendations.

Cantin, Diane, and Lisette Lambert.

Perfectionnement du personnel enseignant du second cycle du primaire. Acquisition d'attitudes non sexistes dans les pratiques et activités pédagogiques. Guide d'animation. Guide de participation. Guide d'activité pour les élèves. Québec: Gouvernement du Québec, ministère de l'Éducation, Coordination à la condition féminine, 1989. The three components of this kit are designed to assist the teachers of primary schools examine the sexism in teaching practices and curriculum materials and to provide non-sexist replacement strategies. *Guide d'animation* (16 pgs.) supplies the necessary tools with which to organize a training workshop for teachers. The overall objectives are three-fold: to sensitize teaching and counselling personnel to the manifestations of sexism, to help them analyze educational practices and to discuss intervention techniques. In the *Guide de participation* (78 pgs.) are exercises for the participants. A workplan provides an overview of the activities and their duration. The activities focus on a wide range of issues from sexist language to the effects of stereotyping on children to sociological factors. Questionnaires and discussion topics facilitate

analysis and reflection. In-class activities are included in the *Guide d'activités* (81 pgs.) . Lessons cite grade level suitability and objectives, and provide questions, written exercises, games and puzzles that help the student explore such topics as stereotyping, sexist language, the relevance of mathematics for girls, and the differences between boys and girls. Bibliographies.
(GQ) (OWD Resource Centre)

Cotera, Martha P.

Checklists for Counteracting Race and Sex Bias in Education Materials. Newton, Mass.: Women's Educational Equity Act Program, 1982. 32 pgs. This handbook provides guidelines and checklists to be used in selecting and evaluating elementary curriculum materials for discrimination and sexual bias. Bibliography.
(WEEA) (OISE/370.19345 C514)

Davis, Barbara Gross, and Sheila Humphreys.

Evaluating Intervention Programs. Applications for Women's Programs in Math and Science. New York: Teachers College Press, 1985. 0-8077-2787-3. 228 pgs. The purpose of this handbook is to assist instructors, directors, and school administrators evaluate and strengthen existing women's programs. There is an overview and rationale of evaluations and their designs, explanations of tools used to gather and assess information (questionnaires, interviews, observations, documents and records), and evaluation strategies for conferences, workshops, speakers, internships, exhibits, and courses and curricula. Illustrated. Resources. Glossary. Index.
(OISE/TCP) (OISE/500.82 D261 E)

Erickson Gaalen, Lynda Erickson, and Sharon Haggerty.

Gender and Mathematics/Science Education in Elementary and Secondary Schools. Richmond, B.C.: Province of British Columbia, Ministry of Education, 1980. 78 pgs. The inquiry focuses upon the lower level of achievement among girls as compared to boys in British Columbia schools. It discusses sex-related differences in science and mathematical achievement, programs designed to help female students such as the "Math for Girls" project, and intervention strategies. Resources. Appendix and Bibliography.
(BCEd) (OISE/370.19345 E68G)

Gouvernement du Québec. Ministère de l'Éducation.

Guide D'Animation. Pareille, Pas Pareils. 1985. Édition revue et augmentée. Gouvernement du Québec, ministère de l'Éducation, ministères des Affaires Sociales, consiel du statut de la femme, 1986. A comprehensive guide to facilitate workshops with preschool educators on the subject of non-sexist education. The nine modules cover the topics of sexism and stereotyping; differences between boys and girls - physiological, personality traits and stereotypes; non-sexist games for equal development; advertising and its negative impact; books, television and songs; division of roles; how to change sex role models; individual and collective actions. Each module outlines the objectives, advanced preparations, materials

needed, exercises and duration, worksheets, and evaluation forms. An Appendix provides additional activities.
(GQ) (OWD Resource Centre)

Industry, Science and Technology Canada.
Women In Science And Engineering: Vol. 1: Universities/Les femmes en science et en génie: volume 1: universités. Ottawa: Industry, Science and Technology Canada, University and College Affairs Branch, Science Sector, March 1991. English 52 pgs./French 52 pgs. This bilingual report provides a statistical overview of women and men enroled in unversity level natural science and engineering programs between the years 1975 and 1989. It finds that engineering and applied science are the least popular fields of study among women, with only 2% of female degree earners graduating in these fields in 1989. Statistical tables are used to look at the numbers of female degree recipients, enrolment trends, and female faculty in engeering, applied sciences, mathematics, physical sciences, agriculture, biological sciences, social science, and health professions and occupations. The report also describes initiatives such as scholarships and mentor clubs which have been established to encourage women into these fields.

Kennedy, DayAnn M., Stella S. Spangler, and Mary Ann Vanderwerf.
Science & Technology in Fact and Fiction: A Guide to Children's Books. New York, NY: R.R. Bowker, 1990. 0-8352-2708-1. 319 pgs. This book contains over 300 annotated references to fiction and non-fiction children's books on science and technology. Selected for both boys and girls, the books will help satisfy childrens' curiosity in as well as build their knowledge base about space, aeronautics, computers, mechanics, robots, and other subjects. The sciences selected include the physical sciences and earth sciences. Each entry includes the age and grade level (the age ranges are from 0 to 11 years, but some books span the age and grade ranges of the middle school and the secondary schools); a summary which reviews the content of the book; and an authoritative evaluation which evaluates the book's literary quality; scientific and technological detail and accuracy; clarity, style and use of language; appropriateness of topic for the intended audience; and coordination of text and illustrations. Five indexes complete the volume: author, title, illustrator, subject, and readability (Fry Readability).

Kennedy, DayAnn M., Stella S. Spangler, and Mary Ann Vanderwerf.
Science & Technology in Fact and Fiction: A Guide to Young Adult Books. New York, NY: R.R. Bowker, 1990. 0-8352-2710-3. 363 pgs. This volume lists over 350 fiction and non-fiction books on the subject of science and technology, selected to appeal to young people of middle school age through high school. A broad range of reading levels is represented - books with a grade 3 reading level to books beyond the grade 12 level. Topics include achievements in space, developments in cosmology, technological devices, nuclear energy, computers and artificial intelligence, fiberoptics, communications, superconductivity, and many others. Fiction titles include works by Ursula LeGuin, Madeleine L'Engle, and Anne McCaffrey. Each entry includes a summary which reviews the content of the book, and an authoritative evaluation which evaluates the book's literary quality;

scientific and technological detail and accuracy; clarity, style and use of language; appropriateness of topic for the intended audience; and coordination of text and illustrations. Four indexes complete the volume: author, title, subject, and readability (Fry Readability).

Labatt, Mary Howarth.

"The Quest for Equity. " ***Federation of Women Teachers' Association of Ontario Newsletter.*** 6 (June 1988): 1-7. The author challenges the myth that racism and sexism have been eliminated by reviewing recent classroom studies which reveal many examples of bias and discrimination. She suggests that schools can play a major role in the quest for true equity - otherwise a majority of Ontario's students will be unfairly treated. References.

(FWTAO) (FWTAO/Journals)

Labour Canada.

When I Grow Up...Career Expectations and Aspirations of Canadian Schoolchildren. A pilot project undertaken for the Women's Bureau of Labour Canada. Illustrated by Rachel Dennis. Ottawa: Labour Canada, 1986. 77 pgs. This work provides evidence that boys and girls are becoming increasingly aware of the changes taking place in the work force where occupations formerly undertaken only by men are now being staffed by women as well. It stresses the need for young girls to be made aware of the realities they may face as adult women so that they can plan their lives for maximum benefits to themselves, their families, and society as a whole.

(LC) (OISE/Ref. 305.234 W567)

Lamont, Betty et al.

Sex Equity in Elementary Education. Bridging the Gap. 1984. Reprint. North York: Board of Education, Curriculum and Staff Development Services, Women's Studies, 1989. 54 pgs. This resource document provides practical strategies for staff, students and parents to assist in the implementation of three objectives: equal educational opportunity, awareness of sex-role stereotyping, and the creation of a non-sexist learning environment. The clearly written strategies can be applied to curriculum (including math, science and computers), co-curricular activities, the community and staff concerns.

(NYBEc) (OISE/370.19345 S5186)

Lewis, Sue, and Ann Davies.

Gender Equity in Mathematics and Science: Girls and Maths and Science Teaching Project. Canberra, Australia: A Project of National Significance, Curriculum Development Centre, 1988. 221 pgs. This book is a professional development resource and documents schoolbased activities that were developed with teachers during the Australian Girls and Mathematics and Science Teaching Project. In keeping with the objective of GAMAST of assisting elementary and secondary mathematics and science teachers develop equitable programs, the authors outline how to incorporate an action research approach in schools. These

methods include in-service activities for diversifying teaching to include girls, designing programs to start from the experience of girls as well as boys, developing skills for implementing change in school programs, and strategies for developing inclusive policy for schools. Worksheets are included. Each section is referenced.
(McC)

Marrett, Cora Bagley.

Teacher Goals and Race/Sex Equity in Mathematics and Science Education. Final Report. Madison, Wisconsin: Wisconsin Center for Education Research, 1985. Microfiches. 164 pgs. This study, which gives particular attention to minority and female students, sought to determine which goals secondary level mathematics and science teachers emphasized and the possible link between these goals and the student-level outcome. The findings indicate a need for further inquiry on teacher objectives in math and science instructionand development of strategies that would prove effective for diverse students. References.
(EricDoc) (OISE/Eric 275 496)

Nicholson, Heather Johnston and others.

"Equity on Purpose: In Pursuit of Excellence in Informal, Out-of-School Interventions in Math, Science and Technology." Paper presented at the Conference of Vision to Reality, Ann Arbor, MI., July 1987. 8 pgs. Microfiche. The Girls Clubs of America are committed to increasing girls' out-of-school participation in the areas of science and mathematics. Non-formal activities which sustain their interest include visits to science and technology museums and science centres; "camp-ins" where visiting girl groups sleep over at a host museum for a weekend of workshops; and television workshops for children. The authors encourage the inclusion of "intentional" math and science programs in the already existing Girl Scouts (Girl Guides), 4-H Clubs, etc., and provide strategies for implementing such programs. They stress the importance of creating an environment of "inquiry" where girls feel comfortable asking questions and of making connections with various resource centres in the community that can provide materials and educators. References.
(Phcopy/OISE or EricDoc) (OISE/Eric 302 401)

Nicholson, Heather Johnston, and Ellen Wahl.

"Operation SMART: From Research to Program — And Back." Paper presented at the International Conference of Girls and Technology, July 1987. 9 pgs. Microfiche. Operation SMART was founded by the Girls Clubs of America in response to the technological revolution that is changing women's roles in the labour market and to meet the needs of young girls from low income and minority families. The paper reviews the founding of Operation SMART and briefly describes the components of the model it incorporated. The program is designed for out-of-school activities and includes scientific inquiry, scheduled learning sessions in science, mathematics and technology, career exploration, family involvement. It also outlines training of staff, staff's experiences with girls in the 6- to

11-year-old groups and adolescents, and their collaboration with schools, community organizations and professional associations. References.
(Phcopy/OISE or EricDoc) (OISE/Eric 302 403)

North York. Board of Education.

Blueprint: Careers...the variable is you. North York: North York Board of Education. This kit is especially designed to assist teachers and female students in the middle level develop positive attitudes towards the study of mathematics, science and technology. It includes a list of resources and organizations, biographical sketches of women who work in these fields, and a section of mathematical and technological exercises providing concrete and positive experience for high school students who may lack self-confidence in these areas. Discussion questions, articles and questionnaires promote career choice awareness.
(NYBEc) (Minkler/371.425 Blu)

Ontario Ministry of Labour.

"Ontario Public Service Professionals with disabilities talk about their careers/Des fonctionnaires handicapés parlent de leurs carrières." ***Profile*****, Issue Two**, 1992. Ontario Ministry of Labour, The Centre for Disability and Work. 0-7729-9282-7. English 32 pgs./French 32 pgs. The biographical profiles in this issue include fifteen women with disabilities working with the Ontario government as lawyers, administrators, technicians, radio dispatchers, policy analysts, and office workers. Each woman describes her career goals, counselling and job training she received, barriers she's had to overcome, and her future aspirations.

Ontario Teachers' Federation.

A Review of Elementary and Secondary Programs on Gender Equity. Toronto: Ontario Teachers' Federation, Status of Women Committee, 1991. 0-88872-096-3. 19 pgs. Spiral bound. Although this review documents the success stories in Ontario schools working to challenge sex-role stereotyping, it points out that there is still much work that needs to be done and highlights many of the programs designed to encourage girls and young women to enrol in mathematics, science and technology courses in order to consider a wide range of career options. Three levels of programs are described: four elementary and secondary level programs; six elementary school programs in Ontario; and ten secondary school programs in Ontario. Each program is briefly described and a contact name, address and phone number are listed. References.

Rogers, Pat, ed.

Proceedings of the CEMSAT Symposium. Glendon College, York University, Toronto, Ontario, May 24-26, 1989. North York, Ont.: The Coalition for Equity in Mathematics, Science and Technology, York University, 1990.106 pgs. The Coalition for Equity in Mathematics, Science and Technology held this symposium to review current theory and practices and to make recommendations for future action and strategies. The publication provides the full text of papers presented.

Researchers active in the field discussed international perspectives on gender differences in mathematic achievement; secondary science education in Canada and the participation of girls; the teacher variable in the equity equation; and feminist pedagogy. Intervention strategies presented cover conferences and job site visits to encourage girls in math and science; science workshops and summer laboratory experiences to promote girls' participation in science; workshops and technical studies for females only to encourage females into technology; and the Women Inventors Project that inspires creativity and entrepreneurship. Each paper is referenced. Bibliography.
(Phcopy/CEMSAT) (OWD Resource Centre)

Sanders, Jo.

"**Developing Software for Gender Equity. *"A Review of Breaking the Barriers, by Pamela Blackstone. The Computing Teacher*** 17 (March 1990):54-55. The author applauds the efforts of the women who created this original software package - one of the few existing programs designed for female students in the early grades. She also points out that this publication will play a valuable role in reminding teachers across North America and elsewhere that "girls' avoidance of computers, mathematics and science is itself avoidable."
(CT) (Minkler/Journals)

Schniedewind, Nancy, and Ellen Davidson.

Open Minds to Equality: A Sourcebook for Learning Activities to Promote Race, Sex, Class, and Age Equity. Englewood Cliffs, NJ.: Prentice-Hall, Inc., 1983. 0-13-637264-3. 273 pgs. The activities in this sourcebook, suitable for grades 3 through 8, examine ways that racism, sexism, class bias, ageism and competitive individualism in school reinforce inequality. Designed as a resource that can fit into existing teaching plans, the activities include role plays, case studies, dilemma stories, co-operative group situations, and interviews. Mathematics is included as a subject focusing on graphs, ratio and proportion, percentage and fractions, statistics, calendar lessons. General References and an Annotated Bibliography.
(PH) (OISE/C.R. 305 S3610)

Scott-Jones, Diane, and Maxine L. Clark.

"The School Experiences of Black Girls: The Interaction of Gender, Race, and Socioeconomic Status." Phi Delta Kappan 67 (March 1986):520-526. The authors review the findings that are available on the achievement of Black females in elementary and secondary science and mathematics. They discuss their educational expectations, aspirations and motivations and suggest that parental methods of socialization, teacher/students interactions and peer interactions correlate with academic achievement. References.
(PDK) (OISE/Journals)

Shapiro, June, Sylvia Kramer, and Catherine Hunerberg.

Equal Their Chances: Children's Activities for Non-Sexist Learning. Englewood Cliffs, NJ.: Prentice-Hall, Inc., 1981. 164 pgs. This guide is written for parents and teachers who want to establish sex equity in schools. Chapter 4 covers mathematics and science providing a brief analysis of sexist stereotyping experienced by female students and concrete suggestions about what can be done to counteract sexism in mathematics and science textbooks. Includes learning activities in spatial skills and exploring the environment that can be adapted to different age levels. References and Sources. Index.

(o/p) (OISE/370.19345 S29E)

Skolnick, Joan, Carol Langbort, and Lucille Day.

How to Encourage Girls Into Math & Science: Strategies for Parents and Educators. Englewood Cliffs, NJ.: Prentice-Hall, Inc., 1982.192 pgs. Suitable for primary, intermediate and junior high, the 69 activities in this guidebook can be applied to any in- class unit or at home. They will help develop competence in spatial visualization, working with numbers, logical reasoning, and scientific investigation. Each activity introduces skill area, grade level, strategies, concept being explored, materials needed, directions. An overview of factors prohibiting girls' confidence and interest in these subject areas introduces the book. Resource list. Index.

(o/p) (OISE/507.1073 5422H: FWTA0/32727 Sko: Minkler/507.1073 Sko)

Stage, Elizabeth, et al.

"Increasing Participation and Achievement of Girls and Women in Mathematics, Science and Engineering." In ***Handbook for Achieving Sex Equity Through Education, 237-268.*** Ed. Susan S. Klein. 0-8018-3172-5. The emphasis of this article is on educational research and program development. It reviews research in the area of sex differences in quantitative and spatial skills, socialization factors, attitudinal and affective factors, and introduces a series of intervention programs. These include special classes for women, the Math for Girls program, classes which address problems faced by female students, the SPACES project, the COMETS science modules, and EQUALS teacher education programs. Extensive references.

(JHU) (OISE/370.19345 H236)

Status of Women Canada and Manitoba Women's Directorate.

Participation of Girls and Women in Math, Science and Technology/ Participation des jeunes filles et des femme en mathématiques, en science et en technologie. Ottawa: Status of Women Canada, 1989. Microfiche. Eng. 27 pg./French 31 pg. This background paper identifies reasons for the under-representation of girls in these disciplines. One of the major factors influencing the enrolment of girls is the exclusion of women's presence from curriculum materials, the use of female-excluding language, and the failure to integrate women's experiences into math and science courses. Recommendations cited include improved educational material content to reflect female experiences; course requirement reviews to ensure that students acquire the level of math,

science and technology they need to function in an evolving society; stronger access and support systems for female students; greater information, career awareness and role modelling.
(CCSD) (OISE/Microlog 89-04848)

Stevenson, Judi.
Gender Equity in Ontario Education: Giving Teachers the Tools to Contribute - A Discussion Paper with Recommendations for Professional Development. Toronto: Ontario Teachers' Federation, July 1992. 45 pgs. The author writes from a position that gender equity is a legitimate and important goal for schools and society to pursue, and she is concerned about its progress. The paper outlines the in-service training initiatives the OTF proposes to develop. It provides a critical study of how gender equity has shifted in meaning, often taking the emphasis off gender equality in education; discusses the research findings on gender in education, both in Canada and beyond, and its effect on curriculum development, sexual harassment, and classroom interaction; reviews the sex equity policy for school boards in Ontario; and provides a brief analysis of equity programs available. Footnotes. Selected Bibliography.

Thomas, Gail E.
"Cultivating the Interest of Women and Minorities in High School Mathematics and Science." ***Science Education*** (January 1986): 31-43. The results of a 1982 survey among college students suggest that students' career choices and aspirations are developed at an early age. The article emphasizes the importance of family intervention in the shaping of students' interest in and attitudes towards math and science: encouraging childhood science hobbies and aspirations of being a scientist, supporting math and science choices and encouraging participation in high school math and science clubs.
(SE) (OISE/Journals)

Tsuji, Gerry, and Suzanne Ziegler.
"What Research Says About Increasing the Numbers of Female Students Taking Math and Science in Secondary Schools." ***Scope*** 4 (February 1990). This issue of the newsletter prepared by the Research Section of the Toronto Board of Education summarizes recent research investigating ways in which female participation in math and science can be encouraged. These strategies include changing the beliefs about the usefulness of math thereby increasing appeal at a cognitive level, and increasing female confidence and achievement levels. On-going efforts on the part of educators can include one-day conferences, staff development and curriculum development. References.
(THE/Res) (Minkler/Journals; TBE/Journals)

Urban Affairs Department, Saint Paul Public Schools.
Minority Women in Math and Science. Saint Paul, Minnesota: Urban Affairs Department, Saint Paul Public Schools, 1982. 44 pgs. This document provides biographical information about Native American, Asian American, Black and

Hispanic women working in math and science-related careers. Teaching materials introduce the history and culture of these women to grades 7 and 12 students. Discussion questions focus on barriers faced by minority women. Glossary of terms. Tables. An appendix outlines professional fields requiring high school math and science.
(WEEA) (OISE/Eric 261 115)

Urban Affairs Department, Saint Paul Public School.
Minority Women in Math and Science. Teacher's Guide. Saint Paul, Minnesota: Urban Affairs Department, Saint Paul Public Schools, 1982. 34 pgs. The guide includes example lessons and activities that can be used with the student booklet above. The eight lessons are structured in a conceptual format and cover the themes of stereotyping, discrimination and careers. Each lesson identifies subject area, grade level, generalizations, behavioral objectives, teaching and evaluation procedures, and includes activities, discussion questions, and worksheets. Resources.
(WEEA) (OISE/Eric 261 116)

Vigier, Rachel, Christiane Pignan-Palmer, Kathy Garnsworthy.
Autre Temps, Autre Moeurs. Guide pédagogique pour une éducation non sexiste. Toronto: OISE Press, 1981.112 pgs. Twenty-four exercises and games can be used by teachers in grades 1 to 8 to raise awareness, outline the roles women play in society, and look at both masculine and feminine stereotypes. Each exercise provides an objective, discussion questions, and grade level. Brief biographical sketches of Canadian women (Anglo- and Francophone) provide role models and a chronological history introduces the suffragette movement in Quebec. Bibliography and Resources.
(o/p) (OISE/370.19345 V676A)

Violette, Michèle.
D'Un Common Accord: Matériel de Soutien Pédagogique sur le Thème de l'égalité entre les filles et les garçons. Enseignement primaire 6e année. Gouvernement du Québec, ministère de l'Éducation, la coordination à la condition féminine, 1990. 2-550-15413-4. 98 pgs. The author acknowledges that educators want all of their students to attain their fullest potential. Yet, despite efforts made by many teachers to teach gender equality, students are still influenced by other messages in their environment - sexism being one among many. Therefore it is important that educators help students develop a critical perspective, particularly about the inequalities that exist between boys and girls. This book is intended to help teachers promote equality. To do this, the author has designed seven modules which are introduced with an illustration depicting a sexist situation. Through in-depth discussion and role playing, the students are able to resolve the sexist conflict and transform it into a more equitable one. This transformed situation is illustrated at the end of the module. The first two modules introduce the concept of sexism - its language and manifestations. The other five provide more direct examples of sexism in televised publicity, **tâches ménagères et éducatives** (camping, for example), non-traditional leisure activities for both boys and girls

(ballet, for example), girls in sports, and girls in non-traditional occupations. Each module cites the approximate time involved, materials needed, preparation required, role plays, questions, discussion topics, observations and interpretations, and vocabulary. The Appendices include video and film resources for non-traditional occupations.

Whyte, Judith, Rosemary Deem, Lesley Kant, and Maureen Cruickshank, eds.
Girl Friendly Schooling. London: Methuen and Co. Ltd., 1985. 0-416-40050-7. 252 pgs. This is a collection of essays presented by British educators at the Girl Friendly Schooling Conference in Sept. 1984. There are three focuses: what makes schooling unfriendly for girls - sex bias, attitudes of teachers towards technology and girls; interventions to make schooling more girl friendly - ex., girl friendly science and sex equality; and future directions. Each essay is referenced. Bibliography. Index.
(MethLon) (OISE/376.941 G525)

"Women in Science & Technology: The Legacy of Margaret Benston." Edited by Ursula Franklin, Hannay Gay, Pat McDermott, and Angela Miles. ***Canadian Woman Studies/Les Cahiers de la femme***, Volume 13, forthcoming Winter 1993. This issue will celebrate the life and work of Margaret Benston, and the work inspired by her contributions to the women's and scientific communities. Among many of her accomplishment was her work in chemistry and computer science. She co-authored a chemistry textbook, co-edited a book on work and new technologies, and wrote numerous articles on the social implications of computer technology. She was particularly concerned about women office workers' health and control over their own work. Margaret died in 1991 after a courageous struggle with cancer.

Yergeau, Nicole.
S.P.R.I.N.T. Stratégie pour réussir l'intégration au non-traditionnel. Guide d'animation. Guide de participation. Guide d'activités. Gouvernement du Québec, ministère de l'Éducation, la coordination à la condition féminine, 1988. This three-part kit is in looseleaf format for insertion in a binder. The 116-page *Guide d'animation* facilitates the organization of a workshop with counsellors and teachers in the secondary level. The first section gives an overview of the Quebec labour market with statistical information illustrating the professional concentration of women and their professional segregation, disparity in incomes and employment patterns between men and women. This leads into the area of career choices for adolescents and the difficulties experienced by women in some non-traditional occupations. How to set up a training session is described in the second section. The step-by-step preparation guide gives materials needed, activities and their duration, subject information, attitudes and techniques. The 59-page *Guide de Participation* provides discussion questions and exercises that focus on the practices and attitudes in the schools where teachers play an important role in career choices. An introductory session provides an overview of the employment situation for young women in the nontraditional workforce and looks at reasons why females don't choose these careers. The following session

challenges attitudes and practices through exercises, questionnaires and cites examples that can be used to reverse non-supportive attitudes. The *Guide d'activités* (189 pgs.) is a workbook of exercises for teachers to conduct in class. The topics include myth and realities, orientation towards non-traditional careers, how to make female students feel welcome in a technical program, support networks for girls, employment information, and evaluations. References and bibliographies.

(GQ) (OWD Resource Centre)

Mathematics
Background Materials

Burton, Leone, ed.

Gender and Mathematics: An International Perspective. Strand, England: Cassell Educational Limited, 1990. 0-304-32279-2. 159 pgs. The fourteen essays in this book are a result of the Women and Mathematics Topic Area at the Sixth International Congress on Mathematics Education, 1988. Presented in four subject areas, Gender and Classroom Practice, Gender and the Curriculum, Gender and Achievement, and Women's Presence, the essays are written by educators in Australia, Singapore, Italy, New Zealand, North America, Europe and East Asia thus providing an international perspective on the current themes being debated at an international level. As well, they present a breadth of approaches using both qualitative and quantitative methodologies, demonstrating the gains and losses to be achieved from each. References.

Burton, Leone, ed.

Girls Into Math Can Go. London: Cassell Education Ltd., 1986. 0-304-31602-4. 257 pgs. A collection of essays that surveys the research work done over the last decade on the influences affecting girls in mathematics. The first section of the book discusses the problems affecting female students: rate of attainment between males and females, attitudes and sex differences, gender roles at home and school. The second section presents strategies educators and researchers have implemented in their classrooms. Each essay is referenced. An appendix provides a herstory of women in mathematics. Index.

(CTY) (Minkler/510.88042 Gir: TBE/QA27.5 G77 1986)

Cassey, Patricia Lund.

"Encouraging Young Women to Persist and Achieve In Mathematics." ***Children Today*** 12 (January-February 1983):8-12. What will keep High School female students in mathematics? Based on two major research studies and her long-term involvement in summer programs to encourage young women into mathematical-related professions, the author found that schools offering functional equivalents of first-year college courses in advanced mathematics opened the possibility of professional careers to many young students who may not have discovered their skills and interests soon enough. The teachers who taught these courses made the difference by providing much needed positive reinforcement.

(Cht) (OISE/Journals)

Chapman, Susan. F., Lorelie Brush, and Donna M. Wilson, eds.

Women and Mathematics: Balancing the Equation. Hillsdale, NJ.: Lawrence Erlbaum Associates, Publishers, 1985. 0-89859-3697. 381 pgs. Among its many purposes, this collection of twelve research articles is intended to help mathematics supervisors and teachers prepare young students for successful working lives. The articles stress women's participation in mathematics, provide summaries of research results concerning the factors that influence student

participation, and informed advice about strategies educators might use to improve participation. References. Index.
(CCP) (OISE/510.88042 W872)

Christensen, Rosemary and others.
American Indian Women and Mathematics: An Annotated Bibliography of Selected Sources. Minneapolis, Minn.: Minneapolis Public Schools, 1982. Microfiche. 25 pgs. This bibliography addresses the factors affecting the participation and performance of Minnesota Native girls in mathematics - socialization, educational exposure and attitudes. The forty-six entries (1967-1982) include journal articles and conference papers. Among the subjects covered are minority group achievements and performance in math, math anxiety and avoidance, academic achievement of Native Americans, and sex-role orientation and stereotyping.
(MPS) (OISE/Eric 234 970)

Eddowes, Muriel.
Humble pi: The Mathematics Education of Girls. York, England: Longman for Schools Council, Longman Resource Unit, 1983. 32 pgs. Based on the poor achievement of British girls in mathematics, the booklet outlines reasons and offers practical suggestions for remedying the situation. Brief strategies draw upon the experiences of practising teachers of mathematics and include classroom approaches and teaching methods, encouragement of girls at all levels, non-sexist teaching materials, school organization, options and career guidance, and extra-curricular activities.
(LRU) (OISE/C.R. 510 E21 M)

Ellis, Dormer, ed.
Math 4 Girls: Four Research-based Essays Concerning the Mathematical Education of Girls. Toronto: Ontario Educational Research Council, 1988. 28 pgs. Three of the four essays in this booklet provide a synopsis of current theoretical discussions: evidence that the proportion of girls studying mathematics can and should be increased; a challenge to the common belief that girls are innately inferior in mathematical aptitude; and the results of an international study of achievement in mathematics of boys and girls. The fourth essay describes initiatives that have been taken to motivate girls to retain mathematics — career conferences, career days, and female-oriented math programs. Each essay is referenced.
(OERC) (Minkler/510.88042 Mat: TBE/QA12.M37 1988)

Fennema, Elizabeth, and Gilah C. Leder, eds.
Mathematics and Gender. New York, NY: Teachers College Press, Columbia University, 1990. 0-8077-3001-7. 214 pgs. This collection of nine essays, written by researchers with a long-standing commitment to the field, reports on various studies that have increased understanding of why females and males learn

different kinds and amounts of mathematics. It also provides insight into the interactions between internal beliefs and external influences, and how they in turn affect the learning of materials. References. Index.

Jeffrey, Adele.

An Investigation Into Math Anxiety Among Elementary Teachers. North York: North York Board of Education, 1988. 39 pgs. The author reviews research which studies the reasons why female elementary teachers experience math anxiety and how this anxiety can influence students. Strategies teachers can use to remedy the anxiety among students are outlined: develop problem-solving abilities, create a supportive learning environment, encourage parental involvement, emphasize career choices, encourage conference attendance. Bibliography. An Appendix provides a Math Anxiety questionnaire for elementary teachers.

(N/A) (Minkler/371.1 0019 Jef)

Kenschaft, Patricia K.

"Black Women in Mathematics in the United States." ***The American Mathematical Monthly*** 88 (October 1981):592-604. This article is among the first to document the achievements of Black women who have earned doctorates in pure or applied mathematics. The author has researched and written brief biographical sketches of their lives with an emphasis on their academic achievements.

(AMM) (OISE/Journals)

Lafortune, Louise, ed.

Femmes et mathématique. Montreal: Les Éditions du remue-ménage, 1986. 2-89091-065-2. 260 pgs. Six Quebec professors and researchers presented their papers at the 1987 conference Femmes et Mathématique. The topics, representing a variety of perspectives, include sexual stereotyping versus positive teaching methods; histories of three mathematicians; research results of a project undertaken to understand the reasons for female underrepresentation in sciences and math; aspects contributing to the mathematical mystique; the importance of family influence in career choices of female students; and reasons for mathematical blocks in female students. Resources. Bibliography. Appendix of notes on workshops.

(DD) (OISE/510.82 F329)

Macfarlane, Jim and Pat Crawford.

Effects of Sex-Segregated Mathematics Classes on Student Attitudes and Achievement in Mathematics: A.Y. Jackson Secondary School Year I. North York Board of Education Research Report, September 1985. 57 pgs. This is the first of three reports documenting the pilot project at A.Y. Jackson Secondary School. Concern over the high proportion of female high school students opting out of math prompted concerned staff members to stream all grade 10 advanced mathematics classes by sex. These students remained in sex-segregated classes until grade 12. This first report discusses the project's methodology and

application, and addresses the four main issues of sex segregated classes and participation rate, students' attitudes towards mathematics, students' achievement, the reaction of students, parents and teachers. Appendices provide a literature review of the subject, questionnaires and interview materials used. (See "Sangster" below for following reports.)
(NYBE/Res) (Minkler/510.712 Mac; OISE/370.780713 N867BER)

McClellan, Kathryn T.
"Math Anxiety: Cause, Impact and Challenge to Black Students." Unpublished paper. Hurst, Texas, 1984. 7 pgs. Microfiche. Math anxiety harshly affects Black students who are underrepresented in many science and engineering areas. The author looks at common causes such as low expectation and callous reaction by teachers to student questions and responses, insufficient role models, failure to be properly trained in early grades. Strategies to counteract these negative factors are outlined.
(Phcopy/OISE or EricDoc) (OISE/Eric 241 270)

"Minorities and Mathematics." Special Issue. ***Journal for Research in Mathematics Education*** 15 (March 1984). 176 pgs. "A rainbow coalition of researchers" attempt to synthesize the available research on minorities and mathematics. Their papers examine learning and participation of minorities in mathematics; mathematics education for Native Americans and Asian Americans; the achievement of Black students; and the underachievement of Hispanics. A brief report of a project held in New York City provides a model to help minority students prepare for mathematics-based careers.
(JRME) (OISE/Journals)

Mura, Roberta, et al.
"Attitudes, experiences et performances en mathématique d'etudiantes et d'etudiants de cinquieme secondaire selon leur choix scolaire." ***Les Cahiers de recherche du GREMF: Group de recherche multidisciplinaire féministe*** 9 (1986). 234 pgs. This study was prompted by the declining enrolment of females in secondary level math courses and the failure of existing research to address or attempt to explain this phenomenon. Among the variables looked at by the authors are subjective value of mathematics, attitudes towards success in mathematics, scholarly and professional aspirations. The document describes the project and analyzes the research data at its various stages. Extensive tables. References.
(GREMF) (OISE/Women's Resource Centre)

Nicholson, Heather Johnston, and Ellen Wahl.
"Who Stole the Cookies? Out-of-school Math in Operation SMART." Paper presented at the Annual Conference of the American Association for the Advancement of Science, Boston, MA., February 1988. 7 pgs. Microfiche. The mathematical activities are designed for females between the ages of 6 and 18 years. Focus is on the principles fundamental to understanding mathematics - deduction, spatial, visualization, ratios, and variables - rather than on drill and

practice. Examples are provided. The importance of staff participation in encouraging females in the study of mathematics and science is emphasized. Critical strategies include self-awareness among staff about their own issues of equity and learned incompetence and keeping records of what does and doesn't work to encourage participation among the female students. References.
(Phcopy/OISE or EricDoc) (OISE/Eric 302 404)

Rogers, Pat.
"Real Women Don't Do Math! A Mathematics Camp for Grade 10 Girls." ***Ontario Mathematics Gazette*** 25 (December 1986):38-43. The author describes one of the three-day residential mathematics conferences (1985 and 1986) held at York University and offered to 10th grade girls from North York schools. The conferences, designed to give the girls a collaborative experience in the process of creating mathematics, are structured on four components: an orientation workshop on mathematical problem-solving skills and strategies; small group problem-solving sessions; discussion groups; and group presentations. The article focuses on the problem-solving workshop, provides sample problems and discusses one group's problem-solving result.
(OMG) (Minkler/Journals)

Sangster, Sandra, and Patricia Crawford.
Effect of Sex-Segregated Mathematics Classes on Student Attitudes, Achievement and Enrolment in Mathematics: A. Y. Jackson Secondary School, Year II. North York: North York Board of Education Research Report, November 1986. 78 pgs. This report summarizes the results of the second year of segregating advanced mathematic classes and assesses student achievement, attitude, participation and the reactions of students and parents to the program. It also discusses teaching styles and strategies and makes recommendations for changes. Appendices include questionnaires used and the analysis of findings.
(NYBE/Res) (Minkler/510.712 San 1986)

Sangster, Sandra.
Effect of Sex-Segregated Mathematics Classes on Student Attitudes, Achievement and Enrolment in Mathematics: A. Y. Jackson Secondary School, Year III. North York: North York Board of Education Research Report, March 1988. 69 pgs. The results for the third year of the pilot project (1986-87) involving Grade 12 students, are presented in four sections: student attitudes towards mathematics, achievement in mathematics, perceptions of the impact of sex-segregated classes and future plans, and participation in mathematics. The difference in trends over the three-year period was of borderline statistical significance providing little evidence of a strong impact of the program on the attitudes of female students. Appendices include questionnaires, longitudinal analyses, and documented student reactions.
(NYBE/Res) (Minkler/510.712 San 1988)

Troemel-Ploetz, Senta.

"Mileva Einstein-Marić: The Woman Who Did Einstein's Mathematics." ***Women's Studies International Forum*** 13 (1990):415-432. The author attempts to demonstrate that Einstein and Marić collaborated on several projects, including the theory of relative motion, and questions why Marić is not mentioned in the various publications about Einstein's work. Born in 1875 in what was once Yugoslavia, Marić was the fifth woman ever to study at the ETH in Zurich and the only woman in her class of 1896. Using the analyses of gender bias, the author shows that this unfair evaluation was applied to Mileva's academic career preventing her from obtaining her Diploma or Doctorate. During their short and troubled marriage, she was invaluable to Einstein in solving many of his mathematical problems.

Wiggan, Lorna.

Mathematics: The Invisible Filter. Toronto: Toronto Board of Education: Mathematics Department, 1983. The four components of this kit include a *Report on Math Avoidance, Math Anxiety and Career Choices*, and three booklets looking at various aspects of mathematics anxiety. The 52-page Research Report documents the results of a project examining the sex-related differences in mathematics among Toronto Board of Education students. They indicate that as females proceed through the grades, their participation in mathematics and related courses decline more sharply than males. The Appendices include "Guidelines for Planning a Career Day" and "Math Anxiety Courses and Programs." Bibliography. The booklets cover the issues of career planning for female students, suggestions for parental support, and strategies for students to overcome math anxiety.

(TBEd/Math) (OISE/370.19345M427;TBE/QA11 M371985)

Willms, J. Douglas, and Suzanne Jacobsen.

"Growth in Mathematics Skills during the Intermediate Years: Sex Differences and School Effects." ***International Journal of Educational Research.*** **Forthcoming.** This study examined differences in the rates at which grades 3 and 7 males and females acquired different types of mathematical skills - mathematical computation, concepts, and problem-solving. " The study is unique in that it emphasized students' rates of growth in mathematics ability, rather than their level of ability at one particular time." References.

(IJER) (OISE/Journals)

Mathematics
Curriculum Resources

Afflack, Ruth.

Beyond EQUALS: To Encourage the Participation of Women in Mathematics. Oakland, California: Mills College, 1982.149 pgs. This resource document is designed for instructors with a goal of encouraging women to participate in mathematics. Emphasis is on problem solving, concrete representation, spatial and logical reasoning. Exercises include introduction to function machines, mathematical functions and application; problem solving; arithmetic and algebra; games and activities. Although it is intended for instructors of adult women, the material could be adapted to secondary level workshops and classrooms. Solutions are provided. Bibliography.

(Eq) (Minkler/W.S. 510.71 Aff; OISE/C.R. 510 A257B)

Avital, Shmuel.

Fun with Mathematics. Toronto: OISE Press, 1986 227 pgs. 0-7744-5075-4. The problems in this workbook are designed for intermediate and high school students. There are eleven chapters of activities, most of which will fit easily into an existing curriculum. Included are patterns, angles, plane and space, fractions, squares, perfect numbers, number chains, division, how to explore and solve problems. Answers accompany each chapter. Glossary of terms.

(OISE) (Minkler/510 Avi; OISE/510 A9595)

Chapline, Elaine B., and Claire M. Newman.

Teacher Education and Mathematics. Flushing, N.Y.: Queen's College of the City University of New York, 1984. Microfiche. The complete package of Teacher Education and Mathematics (TEAM) modules was prepared for use in elementary courses or workshops and is designed to reduce math anxiety and develop math skills. These modules provide a new and comprehensive approach to teacher education that enables prospective teachers to reduce their own math anxiety levels, to develop solid math teaching skills, and to create a positive classroom environment. There are nine sections: Instructors' Handbook, Metric Measurement, Choice and Chance, Sex-Role Stereotyping, Women, Mathematics and Careers, Women as Mathematicians, Approximation and Estimation, Demystifying Math, and Patterns. Each come with teaching and student materials. Bibliographies.

(WEEA) (OISE/Eric 259 917-925)

Downie, Diane, Twila Slesnick, and Jean Kerr Stenmark.

Math for Girls and Other Problem Solvers. Berkeley, California: Math/Science Network, Lawrence Hall of Science, University of California, 1981. 108 pgs. A handbook of exercises for 7- to 13-year-old females introducing them to hands-on experiences in logical thinking and problem solving. Strands include logic, strategies and patterns; more difficult problems requiring a non-obvious solution; creative thinking, estimating and observing; spatial visualization. The handbook

is intended to be used to set up a "math for girls class" in a school, museum, or recreation centre, but it can also be used for workshops or in the classroom as part of the mathematics curriculum. Instructions are written simply and concisely to facilitate teacher preparation. Illustrated, photographs. Index of activities. Bibliography and list of resources.
(MC) (OISE/510 D751M; FWTAO/372.7 Dow)

Federation of Women Teachers' Association of Ontario.
Cartes d'activités métriques: cycle moyen. Traduites et adaptées par L'Association des enseignantes et enseignants franco-ontariens, Ottawa, n.d. 28 pgs. There are sixty-one short activities in this workbook which demonstrate three aspects of metric measurement: linear, surface and volume. Each exercise includes brief instructions, materials needed and discussion questions.
(CFORP) (OISE/C.R. Franco-Ontarien MAT 016)

Hardeman, Carole Hall, and Barbara T. Laquer.
MATHCO Kit. Newton, Mass.: Women's Educational Equity Act Program, 1982. MATHCO is a unique attempt to reach young people at the age when math breakdown occurs - at the junior high/middle school level. The material is arranged in five modules: math and careers, patterns, sequences and equations, math in your world, close encounters with everyday math, math and science. A Teachers' Guide accompanies each module and provides a complete package of all MATHCO materials for the planning and implementation of coursework in conjunction with regular math curriculum. Each module includes a motivational filmstrip presentation with audio cassette, teacher guides and activity sheets (providing an overview of the activity, a listing of math skills used, time needed, objectives, a list of materials needed), and student activity sheets (overview of activity, listing of math skills needed, materials, directions for completing activity). An Inservice Manual is included providing instructions for a teachers' workshop to familiarize them with MATHCO contents.
(WEEA) (OISE/C.R. 507 H258M)

Kaseberg, Alice, Nancy Kreinberg, and Diane Downie.
Use EQUALS to Promote the Participation of Women in Mathematics. Berkeley, California: Lawrence Hall of Science, University of California, 1983. 134 pgs. The purpose of this manual is to train educators through workshops providing them with the tools to teach students in classroom settings. The emphasis is on math avoidance among females in the elementary and secondary levels. Strategies and materials are designed to encourage female students to continue in mathematics courses throughout their schooling, increase students' confidence and competence in doing mathematics, and relate the usefulness of mathematics to future career choices. The Appendices provide sample workshops, problem-solving activities, career activities and bibliographies.
(Eq) (Minkler/W.S. 510.71 Kas; OISE/C.R. 510 K192u)

Krause, Marina C.

Multicultural Mathematics Materials. Reston, Virginia: The National Council of Teachers of Mathematics, Inc., 1983. 76 pgs. This illustrated workbook introduces games from Africa, Asia, Oceania, Europe, and the Middle East, with a special section devoted to the Hopi Indians of North America. Many activities cross grade levels ranging from grades 1 to 8. Each activity, designed for immediate use with only simple materials required, is introduced with an historical background, materials needed, object of game, how to play, number of players, and references. They include Egyptian numeration, *Ko-no* (a Korean line game), Origami cup, petroglyph, dreidel, Quipu (Inca record keeping), Aztec calendar, Hopi Rain Cloud (circles and half circles), Hopi Bird (study of geometric shapes).

(NCTM) (OISE/C.R. 510 K91 M)

Massialas, Byron, G. Project Director.

Fair Play: Developing Self-Concept and Decision-Making Skills In the Middle School. Decisions About Mathematics. Student Guide. Newton, Mass.: Women's Educational Equity Act Program, 1983. 120 pages. The eighteen lessons in this book explore female and male attitudes towards mathematics and look at factors that discourage female students from math studies. Suitable for grades 6 to 9, the exercises and questions demonstrate how math is a part of daily life and illustrate female occupations that incorporate mathematical skills. Concepts such as collecting and analyzing data, frequency tables, mean, mode and median, ratios and percentages, and line and circle graphs are demonstrated. There is a strong emphasis on women in the workforce and career planning in mathematical professions for female students. Illustrated. Clear language.

(WEEA) (OISE/C.R. 305.3 M417F V.4)

Massialas, Byron G. Project Director.

Fair Play: Developing Self-Concept and Decision-Making Skills In the Middle School. Decisions About Mathematics Teacher's Guide. Newton, Mass.: Women's Educational Equity Act Program, 1983. 133 pgs. The guide provides an overview for each lesson which includes duration of class, student objective, teaching suggestions, purpose, vocabulary learned, background information and special preparations if necessary. It also gives answers to in-class activities, and suggests points for in-class discussion with an emphasis on roles women play in the home and in the work force, social differences between men and women, pay inequity. Print and audio-visual resources.

(WEEA) (OISE/C.R. 305.3 M417F V.4 T.G.)

Percevault, John B. and Gordon Orlick.

Teaching Mathematics in the Early Childhood Classroom. Edmonton, Alberta: The Alberta Teachers' Association, 1987. 0-920696-43-0. 106 pgs. This document combines theory and practical application. Twenty-four articles explore learning strategies for pre-kindergarten, kindergarten and primary students emphasising curriculum development and mathematics as creativity. The activities focus on

problem solving, pre-number concepts, pattern and rhythm, winter mathematic activities, manipulative games, primary geometry, arithmetic, and graphing. References.
(ATA) (Minkler/372.72044 Tea)

Perl, Teri Hoch, and Joan M. Manning.
Women, Numbers and Dreams. Biographical Sketches and Math Activities. Graphic Design: Analee Nunan. Santa Rosa, California: National Women's History Project, 1982. 0-938625-07-1. 191 pgs. This book provides role models for young women and introduces a variety of mathematical concepts suitable for grades 3 to 8. The sketches of thirteen women - both contemporary and historical - are graphs incorporating number theories such as multiples, prime numbers, triangulars, abstract algebra, and fibonacci numbers. Additional mathematical activities explain the concepts while the biographical sketches portray women who applied them in their daily work lives: computer programmer Ada Lovelace, mathematician Mary Boole, linguist Mary Somerville, Native American and statistician Edna Lee Paisano. "The reader is permitted and encouraged to make photocopies of the math activities."
(NWHP) (FWTAO/372.7 Per)

Perl, Teri Hoch, and Joan M. Manning.
Women, Numbers and Dreams. Biographical Sketches and Math Activities. Teacher's Manual. Santa Rosa, California: National Women's History Project, 1982. 25 pgs. This manual suggests ways of integrating *Women, Numbers and Dreams* into a teaching program. Math activities have been included with the biographical sketches to show that mathematics is far more than the arithmetic learned in elementary school. Shade-in exercises introduce a wide range of concepts: "shade all multiples of 9" to "shade all regions containing decimal numbers that are symmetric when translated into binary form." Additional exercises extend explanation; role playing and discussion questions for eachbiography integrate real life applications. Two lesson plans are included providing models for developing projects, activities, and discussions around the various stories in the book.
(NWHP) (FWTAO/372.7 Per)

Saunders, Hal
"When are we ever gonna have to use this?" ***The Mathematics Teacher 73*** (January 1980):7-16. In order to answer this question asked by many high school students, the author interviewed 100 people from a variety of occupations to determine what kind of mathematics they actually use in their work. Typical mathematical problems encountered in these occupations were collected during the interviews and, along with strategies and recommendations for teaching, eighteen are included in this article. The occupations include pharmacist, air traffic controller, electronics engineer, meteorologist, environmental biologist, auto mechanic, and farmer.
(MT) (OISE/Journals)

Toronto Board of Education. Mathematics Department.

Calendar Math. Mathematics Activities for Adults and Children to do together in the home. Toronto: Mathematics Department, Toronto Board of Education, 1988. This twelve-month calendar, reissued yearly, is an opportunity for parents and teachers to work together with their children to help them enjoy mathematics. The collection of activities relates to monthly themes and centres around Grades 3 and 4, but many can be simplified for students in earlier grades or extended to Grades 5 and 6. Each month has about five ideas for projects that include recipes, constructions, experiments, puzzles or problems, and outdoor activities.

(LP)

Wiggan, Lorna, et al.

Everyday Math 1. Toronto: Learnxs Press, 1980. 0-920020-12-7. 156 pgs. A variety of exercises for students in grades 7 to 10. Mathematical concepts are applied to everyday life situations and activities such as reading the newspaper, shopping, employment, and eating. The activities cover non-computational use of numbers, fractions, decimals, percents, and ratio and rate. Illustrated. Graphs and tables.

(LP) (OISE/C1 4140 E93; FWTA0/372.7; Wig/ TBE/QA39.2 E93 1980)

Wiggan, Lorna, et al.

Everyday Math 2. Toronto: Learnxs Press, 1980. 0-920020-13-5. 116 pgs. More exercises for students in grades 7 to 10 which cover the mathematical concepts of linear measurement, area, temperature, time, volume-capacity, mass, and measurement review. Illustrated.

(LP) (OISE/C14140E93; FWTA0/372.7 Wig; TBE/QA39.2 E932 1980)

Science
Background Materials

"A Celebration of Women in Science." Special Issue. Discover the World of Science 12 (December 1991). 88 pgs. Profiles eleven women "engaged in a wide variety of fields, from anthropology to neuroscience and ecology. Some of their work is immediately tangible, like the high-tech computer art of Donna Cox; some is highly theoretical, like Helen Quinn's quest for the nature of atomic reality. And some of their work is quite provocative". Other scientists profiled work in the fields of astrophysics, paleonthropology, ecology, and archeology.

Ainley, Marianne Gosztonyi, ed.

Despite the Odds: Essays on Canadian Women and Science. Montréal: Véhicule Press, 1990. 0-919890-96-2. 452 pgs. This book of essays documents the accomplishments and difficulties of women in science in nineteenth and twentieth century Canada. The essays are presented in three sections: historical, biographical and contemporary concerns. Together they reflect "a broad view of science that includes medicine, mathematics, social and applied science, technology, and innovation, and presents science as a social activity practiced in a variety of settings on many different levels". The historical essays deal with the larger issues concerning women's entry into, and participation in, science and address issues concerning women as users of specific technologies. The biographical section provides detailed studies of seven women in a variety of sciences. And "contemporary concerns" deal with issues such as girls and computers, career expectations and opportunities, status of women scientists in the 1980s, and changing faces of science in a contemporary Canadian context.

Beauchamp, Rachelle Sender.

"Women inventors project." ***Federation of Women Teachers' Association of Ontario Newsletter*** 6 (June 1988):21-24. The Canadian Women Inventors Project in Waterloo, Ontario, is an educational program with the objective of breaking the cycle of women's exclusion from technical creativity. This article provides a background of the Project, describes a video about women inventors and a one-day pilot workshop held in Sept. 1987. "Women's inventions and the whole subject of inventing itself were excellent tools for turning girls on to the excitement and creativity of science, technology and entrepreneurship and interesting them in non-traditional occupations."

(FWTAO) (FWTAO/Journals)

Bournival, Marie-Thérèse.

"Profession? Femme de sciences!" ***La Gazette des Femme, Conseil du Statut de la femme*** 8 (Novembre-décembre 1986):8-15. This article profiles women ranging from high school and college students actively pursuing careers in science to women working in the field. Interviews are conducted with high school students in Montreal pursuing medicine, an award-winning university chemistry major, a

statistician college major, a geneticist and an anthropologist. The women talk about gender differences, their future ambitions, experiences at school, and their determination to make it in a changing world. References.
(GF) (OISE/Women's Resource Ctr.)

Canham-Rayner, Marelene F., and Geoffrey W. Rayner-Canham.
Harriet Brooks: Pioneer Nuclear Scientist. Kingston: McGill-Queen's Univeristy Press, 1992. 0-7735-0881-3. 192 pgs. Harriet Brooks (1876-1933) was one of the leading women experimental physicists of her day and one of the first Canadian researchers in the field of radioactivity. Given the significance of Brooks' accomplishments, it is surprising that she is not better known: she was the first to identify "emanation" (radon), a vital piece of work that led Ernest Rutherford, her teacher as well as an avid supporter of her work, to propose the transmutation of one element into another; and she discovered the recoil of the radioactive atom. In this book the authors provide the first account of this remarkable scientist's life, following her from her undergraduate work at McGill University to her postgraduate work at Bryn Mawr College and Cambridge University, and documenting the myriad problems facing her as she pursued and fought for her place in the scientific community. Includes 15 b&w photographs.

Chauvin, Marny.
"Women in Science - What Schools Can Do." ***Comment on Education*** 17 (April 1987):19-25. Despite the optimistic observations of the late 1970s indicating that more Canadian women were entering careers in science, engineering and technology, current statistics show that women remain anomalies in these fields. The author looks at reasons why female students don't enter science courses and what schools can do to affect change. Strategies include emphasis on parental support of science studies, discussion in high school classes focusing on the difficulties women face of balancing a career and family, and introducing science courses earlier in the elementary level. References.
(COE) (OISE/Journals; Minkler/Journals)

Ching Hilda Lei, ed.
Proceedings of the First National Conference for Women in Science, Engineering and Technology/Actes de la Premier Conference Nationale des Femmes dans les Sciences, le genie et la technologie. Vancouver, B.C. May 20-22, 1983. Sponsored by the Society for Canadian Women in Science and Technology. The published proceedings of this groundbreaking conference are intended to provide the basis for future ideas, discussions, and strategies for change. The three sections consist of major addresses and papers, panel discussions, and workshop summaries. Participants discussed intervention programs, science education, expanding female students' horizons, girls and women in math and science. Workshops surveyed current strategies such as EQUALS. List of participants.
(SCWIST) (OISE/Women's Resource Centre)

"Femmes et Science/Women and Science." ***Resources for Feminist Research/Documentation sur la recherche féministe*** 15 (November 1986). 87 pgs. This issue presents the many ways that women engage in scientific endeavours - not all of them recognized by official Science. The five sections reflect this diversity: the status of women scientists in Canada; barriers facing women in scientific professions; women and scientific knowledge; women's scientific practices in nutrition, food production, home economics; and the search for a new approach to science. Extensive references.
(RFR) (OISE/Journals)

Ferguson, Janet.
Who Turns the Wheel? Proceedings of a Workshop on the Science Education of Women in Canada. Ottawa: Science Council of Canada, 1981. 136 pgs. The papers presented at the workshop held in 1981 addressed important issues affecting girls in Canadian science classes: their enrolment and achievement in high school science, sex differences in intellectual ability, the roles of educators and teachers, assessment and recommendations of intervention techniques. Endnotes provide references.
(SCC) (TBE/Q130.W67; OISE/305.435 W926W)

"Girls in Science: Discovering Their Choices." Edited by Jan Clarke. ***Women's Education des femmes*** 9 (Summer 1991). 64 pgs. English with French summaries. The fifteen articles in this special issue provide a wide range of women's and girls' voices on the subject of science education. Many of the articles focus on strategies for taking girls' interest and aspirations in science and technology seriously: a review of "Here Today...Where Tomorrow?", an annual program for young women providing an integrated, activity-centred approach that helps girls explore methods, tools and materials associated with various trades and technical occupations; a review of the six-day Science and Technology Career workshops which introduces young women to science careers; and a review of the Women Do Math and Ms. Infinity projects at Simon Fraser University. Other articles include an interview with Ursula Franklin, summer science for girls, and an account of the Women Inventors Project, Daughters of Invention. The common thread throughout is the importance of presenting math and science to girls in ways that include them, by focusing on creative student-centred projects. Bibliography.

Government of Ontario. Ministry of Education.
Inventory of Ontario Women in Scientific and Technical Fields./Répertoire des femmes dans les domaines des sciences et de la technologie en Ontario. Toronto: Government of Ontario, Ministry of Education, 1988. Eng. 53 pgs./French 55 pgs. The inventory can assist secondary school science teachers in finding resource people within their own geographical areas in order to provide female students with role models in non-traditional scientific and technical careers. The occupations cover related professions and trades in life science, earth and space science, and physical science. The speakers are drawn from all regions of Ontario.

The directory includes the professional's name, phone number, occupation, region, and grade level suitability.
(ONMe) (OWD Resource Centre)

Gouvernement du Québec. Ministère de l'Éducation.
Pour me brancher sur l'avenir, je choisis la science et la technologie. Gouvernement du Québec, ministère de l'Éducation, coordination à la condition féminine, 1987. A comprehensive information kit for educators and students informing them about non-traditional career options. A 62-page booklet, A *Chacune son métier*, contains interviews with twenty-five women in non-traditional work. An informative 114-page guide for adolescents, *Explorons de nouveaux espaces*, discusses non- traditional work for women in a technological age. It also provides a bird's-eye view of female students participating in a wide range of non-traditional programs. The students speak candidly about their experiences revealing the prejudices and barriers as well as their personal methods of combatting them. Finally it outlines secondary level studies needed to prepare for non-traditional occupations and looks at available post-secondary courses. Other items included in the kit are a poster promoting women's non-traditional careers, audio visual resources, and a compilation of articles on the subject. References and bibliographies are cited in the two publications.
(GQ) (OWD Resource Centre)

Harding, Jan.
Switched Off: The Science Education of Girls. York, England: Longman for Schools Council, Longman Resources Unit, 1983. 56 pgs. Focusing on the British school system, the author discusses ways in which stereotyping operates, how out-of-school experiences influence boys and girls differently, types of science courses offered, and roles that guidance and counselling play in course selection and career options. She presents a range of strategies that schools can draw on to extend and promote girls' opportunities in science. References and further readings.
(LRU) (OISE/C.R. 507 H263S)

Humphreys, Sheila M.
Women and Minorities In Science: Strategies for Increasing Participation. Boulder, Colorado: Westview Press, Inc., 1982. 0-86531-317-2. 218 pgs. The twelve authors of this book assess what can be done to change attitudes of both students and educators so that women and minorities can achieve full participation in scientific and mathematics-related professions. Throughout the emphasis is on intervention strategies from teacher training to high school career paths for women in physics. References.

(WV) (OISE/305.435 W872)

Kahle, Jane Butler, ed.

Women In Science. A Report from the Field. Philadelphia Press, 1985. 1-85000-020-4. 251 pgs. The focus of the nine essays in this collection is on women in the biological sciences. Topics discuss entrance patterns and retention and reward systems, differential pay scales, the double bias of racism and sexism facing minority women, the underemployment and underutilization of women in science. Of particular interest are two essays: "Retention of Girls in Science: Case Studies of Secondary Teachers" and "Factors Affecting Female Achievement and Interest in Science and in Scientific Careers." Each essay is referenced. Author and Subject Index.

(FP) (THE/Q130.W658 1985; OISE/305.435 W8722)

Klainin, Sunee, Peter J. Fensham, and Leo H.T. West.

"The Superior Achievement of Girls In Chemistry and Physics In Upper Secondary Schools In Thailand." ***Research In Science & Technological Education*** 7 (1989):5-14. Grades 10, 11 and 12 female students in Bangkok, Thailand outperform boys in upper secondary school chemistry and physics. The authors suggest that influences come from the structure of the curricula (those who opt for the science stream must do biology, chemistry, and physics for three years), and the fact that physical sciences are not male dominated. These explanations may provide a framework to apply to investigations in western countries where gender imbalances are being addressed. Tables. References.

(RSTE) (OISE/Journals)

Malcom, Shirley A.

"Who will do Science In the next century?" ***Scientific American*** (February 1990):112. The author gives a synopsis of the critical situation in the United States in the field of scientific occupations. She warns that there will be a serious shortage of scientists in the coming years unless the students now entering or wanting to enter scientific studies, the majority of whom are minority and female students, are welcomed into and encouraged to succeed in the scientific community.

(SA) (Minkler Journals)

Manthorpe, Catherine A.

"Men's Science, Women's Science or Science? Some Issues Related to the study of Girls' Science Education." ***Studies In Science Education*** 9 (1982):65-80. The author introduces a critical analysis of "equality of opportunity" stating that it is not enough to "attract" girls into science. She agrees that facilities for girls in science must be improved, and argues that in addition the structure of science, the social relations upon which science is built, must be altered in order to remove the greater barriers preventing girls from attaining successful scientific professions. References.

(SSE) (OISE/Journals)

Mura, Roberta.

À la recherche de la subjectivité dans le monde des sciences: point de vue féministes. Ottawa: Institut Canadien de recherches sur les femmes, 1989. 47 pgs. How would a feminist perspective affect scientific study? How would women's involvement affect reproductive technology, for example? Is the female concern with life-giving rather than life-destroying forces any reason to deny women access to scientific work? These are just some of the challenging questions the author raises in this critical analysis of the scientific world. Taking into consideration the works of critical thinkers such as Evelyn Fox Keller, Luce Iragaray and Sandra Harding, she demonstrates how and why women have been underrepresented in scientific endeavour, and argues against the notion that objectivity is a more superior approach than subjectivity. The women active in the field today are introducing new and innovative paradigms to the physical, applied, pure and natural sciences which incorporate women's concerns and demonstrate that even though women approach scientific study differently than men their work is of no lesser value. References.

(CRIAW) (OISE/305.40971 C928)

Mura, Roberta, Meredith Kimball, and Renée Cloutier.

"Girls and Science Programs: Two Steps Forward, One Step Back." In ***Women and Education: A Canadian Perspective.*** eds. Jane Gaskell and Arlene McLaren, 133-149. Calgary: Detselig Enterprises Limited, 1987. A study of students in the last year of secondary schools revealed that it is not necessarily anxiety or lack of ability that keeps female students from mathematics, rather it is that careers in math and science are made to seem incongruous with female roles - especially motherhood. In order to encourage greater participation of women, it is important that women's concerns be reflected and that the system be changed to meet women's as well as men's needs. References.

(DET) (OISE/376.971 W872)

Ogilvie, Marilyn Bailey.

Women In Science — Antiquity through the Nineteenth Century: A Biographical Dictionary with Annotated Bibliography. Cambridge, Mass.: The MIT Press, 1986. 0-262-15031-X. 254 pgs. This very well designed dictionary documents the contributions women have made to science throughout history. The introductory essay provides an historical context with brief overviews of major chronological periods from Antiquity to the 20th century. The biographical accounts, arranged alphabetically, include vital statistics, an overview of the women's scientific work, and coded references to the Annotated Bibliography for further reading. The dictionary is a valuable learning tool as well as a resource for further research.

(MIT) (OISE/509.2 034W)

Panabaker, Janet.

Inventing Women: Profiles of Women Inventors. Etobicoke, Ontario: The Women Inventors Project, 1991. 57 pgs. Most of the twenty-three inventors profiled in this booklet are not technical wizards, but ordinary women and girls who were looking for a solution to a problem. Their inventions include technological and medical innovations, products by and for women, childcare improvements, and products for everybody. These women, whose professions range from scientist to actor to microbiologist to student, describe what they were looking for and how they found their answers. Teachers can use this book as part of a module on science and technology or inventing. Questions for discussion have been included and can be modified to suit particular age groups and applications. Bibliography.

Raat, Jan H., Jan Harding, and Ilja Mottier.

"Proceedings: GASAT Conference 1981. Reports on the Conference Girls and Science and Technology." Vol. 1. Eindhoven, The Netherlands: Eindhoven University of Technology, 1981. Microfiche. 37 pgs. This report provides a succinct overview of the strategies formulated at the conference reflecting the objective of increased participation of girls and women in science and technology. These include teacher education, on-going research, support for women outside the classroom, intervention strategies, development of curriculum and teaching materials, teaching methods, and classroom management. There are two other volumes of published materials from the conference. Volume 2 documents the twenty-one papers presented, and volume 3 outlines initiatives taken by the participating countries.

(EricDoc) (OISE/Eric 262 995-997)

Rand, Donna, and Lydia H. Gibb.

"A Model Program for Gifted Girls In Science." ***Journal for the Education of the Gifted*** 12 (Winter 1989):142-155. This article discusses background information and related research concerning the "girls only" program. Basic components of the program include parental involvement, female role models, hands-on investigations, and enjoyment of science activities. Brief descriptions of two sample activities are provided. The model can be adapted in the public or private school or by a community group and is applicable to the general population of girls as well as gifted girls. Bibliography and References.

(JEG) (OISE/Journals)

Rosser, Sue V.

Female-Friendly Science: Applying Women's Studies Methods and Theories to Attract Students. Elmsford, N.Y.: Pergamon Press, Inc., 1990. 176 pgs. 0-08-037470-0. A severe shortage of trained scientists is predicted for the 1990s, and it is indicated that among those most qualified and eligible to alleviate this shortage are women and minorities. The issue of how to attract and keep women and people from diverse backgrounds in the fields of science is the focus of this recently published work. The suggestions, based on feminist pedagogical methods and theories of women's studies, will be useful to science and health educators at

the secondary and college levels who are interested in opening up their science classrooms to women and people of colour. The contents include a review of the crisis in higher education, feminist theories and methods that can make course content less alienating for women, approaches in teaching science that connect to students, research by women scientists reflecting women's ways of knowing, sexism in textbooks, and warming up the classroom climate for women. Bibliography of feminism in science, feminist pedagogy, feminist theory, and women and science. Index.
(PERG) (OISE/Women's Resource Centre; OISE/CIRC-507.11/R828F)

"Science and Technology." Edited by Ronald Mickens. ***Sage: A Scholarly Journal on Black Women*** VI (Fall 1989). 86 pgs. Focusing on the roles and contributions of Black women in science and technology, this issue of *Sage* includes a selection of ten essays. Five feature essays provide an historical context for viewing both the roles and contributions of Black women in mathematics, invention, biological science, and engineering. The five personal narratives by women working in the fields of biology, mathematics and chemical engineering discuss the factors that influenced their decision to pursue careers in science and the difficulties and accomplishments that followed. Bibliography.

"Science and Technology/Science et technologie." Edited by Ursula Franklin and Jeanne Maranada. ***Canadian Woman Studies/Les Cahiers de la femme*** 5 (Summer 1984). 95 pgs. This issue provides a broad range of background reading on women in science and technology from the impact of microtechnology on society and the technological effects on the workplace to the attitude of females towards mathematical studies and pursuit of professions in science and technology. While some articles provide analysis others suggest ways to encourage young females into these professions. Interviews with women scientists and mathematicians, biochemists and electricians discuss the achievements and concerns of women working and studying in these areas. References.
(CWS) (OISE/Journals)

Terlon, Claire.
"Filles et garçons devant l'enseignement scientifique et technique. Recherches anglo-saxonnes." ***Revue Française de Pédagogie*** 72 (Juillet-août-septembre 1985):51-59. The author provides a brief review of the existing English literature (1963-1980) that focuses on cognitive differences between males and females and socialization of the sexes. This research brings to the public's attention the problems contributing to the gender gap and the diverse strategies that are providing direction for students, parents, guides and administrators, promising more equal involvement of females in scientific and technological professions. References.
(RFP) (OISE/Journals)

Wallace, Elizabeth.

The Book for Women Who Invent or Want To/Vous Êtes Inventrice ou Voulez le Devenir? Ce guide est pour vous. Etobicoke, Ontario: The Women Inventors Project, 1989. Eng. 122 pgs./French 130 pgs. Spiral bound. This book is aimed at women who have ideas for new consumer products and services and are wondering what to do with them. It could be used to encourage secondary students to pursue creative ideas. Part I takes the inventor from the concept stage through market research to packaging and manufacturing. It allows the inventor to explore her idea, determine whether it will work or not, and provides key steps needed in building the self-confidence to see the project through. Each chapter in the section concludes with key questions and space to list steps still needed to take. Part II facilitates learning in groups and encourages women to find other women inventors. Listed among the lengthy Appendices are Federal and Provincial Government Agencies, Associations and Organizations, Journals and Publications, a Sample Confidentiality Agreement.

"Women in Science: Options and Intolerance." Edited by Rachelle Sender Beauchamp and Lisa Avedon. ***Women's Education des femmes*** 9 (Fall 1991). 72 pgs. French and English articles. The fifteen articles in this issue focus on transforming the science curriculum in order to encourage and increase the number of women scientists. They look at the exclusion of women from careers in science and the low numbers of women entering sciences; provide an account of an attempt to establish a new engineering programme in a Canadian university; review of the African Training and Employment Centre whose programmes include micro-computer training and training in computer numerical control machines; review of the Bridges to Equity training program in Toronto; provide stories by women engineers about problems they face; and discuss gender harassment and discrimination and how to transform mathematics pedagogy.

Whyte, Judith.

Girls Into Science and Technology: the Story of a Project. London: Routledge and Kegan Paul, 1986. 0-7102-0364-0. 290 pgs. This book is an account of the Girls Into Science and Technology Project undertaken at the Manchester (UK) Polytechnic, 1979-1984. Designed as an action research program, GIST had the twin aims of investigating the causes of female underachievement and simultaneously trying to change the situation. The author describes the need for GIST and the research design, looks at the ways girls are "edged out" of classes, discusses the program's intervention strategies, identifies components of girl-friendly science, looks at the pros and cons of single-sex and mixed-sex schooling, analyzes teachers' responses to GIST, and describes the effect of the five-year program. Tables. Bibliography. Appendix. Index.

(RCH) (OISE/507.1041 W629G; TBE/Q183.4 G7 W48; FWTAO/372.3 Why)

Women Inventors Project.

Inventors Want to Know: A Reference Guide on Entrepreneurship and Innovation for Information Providers. Etobicoke, Ontario: The Women Inventors Project, 1990. 127 pgs. Spiral bound. This well-presented Reference Guide is intended for front-line, program-delivery staff who work with entreprenuers and inventors. It could also be adapted for advanced secondary-level classes. The six self-contained modules provide information to the questions most frequently asked about new product development: starting out - project planning and market research; legal questions; design and materials; finance; marketing; and specialized products. The modules also includes important issues to consider, key information, background information, resources, and profiles of real-life inventors or entrepreneurs. A Reference Guide Matrix helps identify the modules most relevant to each stage of product development. Appendices. Subject Index.

Women Inventors Project.

Daughters of Invention: An Invention Workshop for Girls. Handbook for Planners. Waterloo, Ontario: The Women Inventors Project, 1988. 85 pgs. Three-hole punched for binder. This manual is designed to help teachers and workshop facilitators create a one-day event for female students. The contents can be applied to grade K through 12. The handbook is divided into two sections. The first provides an overview of the Women's Inventors Project and its pilot invention workshop for girls held in the fall of 1987. The second section and the accompanying 14 appendices provide the nuts and bolts of workshop organizing. Tasks outlined include: identifying objectives and goals, age groups and numbers of participants, assembling a management team, financial budgets, resources, and time lines. Among the items illustrated in the appendices are: tips on learning styles for girls and how to encourage group learning, a glossary of inventors' terms, sample patent drawings and abstracts, a bibliography, a herstory of inventing, examples of workshop activities from self-development to creative and inventing activities, and a list of women's inventions available for display.

(WIP) (OISE C.R.608.7/W191D)

Science
Curriculum Resources

Adams, Richard C.

Science with Computers New York: An Experimental Science Series Book, Franklin Watts, 1987. 0-531-10324-2. 128 pgs. The author, a science and computer science teacher and a columnist with *The Computing Teacher*, has written a very clear, accessible book for secondary-level students. The objective is to show how computers can be used in conjunction with science projects making data easier to handle, mathematics a whiz, the results more valid and easier to interpret. Programs are designed for Apple II series of computers with BASIC computer language. Ideas for science projects without computers are also included. Lessons cover number crunching, statistics, sorts and data bases, simulations, computer as a laboratory tool, and word processing. Glossary. Appendices. Selected Readings. Index.

(FRK) (TBE/Q183.9 A33 1987)

Baeckler, Virginia.

Storytime Science. Illustrated by Vera Johns. Hopewell, New Jersey: Sources, 1986. 0-9603232-28. 102 pgs. This book offers a unique approach to introducing science to nursery and elementary level children. The author's premise is that story hour is a time of magic and wonder when children "transcend the practical limits of everyday thinking and plunge into the world of make believe." After telling them a fanciful story, the time is right for exploring the world of the unknown. Power is the theme of the twenty-seven storytime experiments: power of air, liquid, heat, battery, light, vibration, growth, and decay, and self-power. Each experiment provides a list of suggested stories that can be used in conjunction with the experiments. Additional notations provide a brief introduction to the activity and list the needed materials. Discussion is encouraged and homework provides a follow-up to the lesson. Appendices.

(Sou) (TBE/TJ163.95 B29 1986)

Barker, Susan, Shelley Beauchamp, and Ed James.

From Idea to Invention: Course Materials for Teaching Invention and Innovation. Etobicoke, Ontario: Women Inventors Project, 1992. 0-921808-06-2. 121 pgs. Spiral bound. This book is designed to support the new guidelines for entrepreneurial and scientific studies at all levels as prepared by the Ontario Ministry of Education. It can be integrated with regular curriculum materials or used as a stand-alone unit for gifted education or independent study. It is recommended that students begin, individually or in small groups, with brainstorming and warm-up activities, then be offered the opportunity to build their own inventions thus making inventing a fun and hands-on activity. There are ten chapters covering the key areas involved in inventing: inventing basics, creative thinking, idea assessment, planning, prototypes, finance, patents, manufacturing, packaging and marketing. In addition to activities and instructions, each chapter contains topic information for teachers, including suggestions about curriculum, and age and ability levels; information for students; and resources.

Brooks, Phyllis, and Jane Fletcher.

Careers for Girls in Science. Toronto: Toronto Board of Education, Science Department, n.d. 60 pgs. Provides biographical profiles of twelve contemporary Canadian female scientists. In clearly written language the women discuss their work - these include an aeronautical engineer, obstetrician, registered nurse, forestry technical assistant, laboratory technician, and chemical engineer.
(TBE/Sc) (Minkler/507.088042 Bro)

Brown, Ken, and Don Plumb.

Keeping Your Options Open. North York: North York Board of Education, n.d. This kit of sixteen transparencies is designed to facilitate an in-class presentation to grade 10 female science students to educate them about the evolving job market and present career options in the fields of high-technology. The transparencies focus on statistical information about female enrolments in maths and sciences, careers requiring a science background, inequality in the workforce, women who do science, and a summary. Follow-up activities, audio-visual resources and a list of speakers complete the kit.
(NYBEc) (Minkler/507.088042 Brow)

Connors, Wayne T. et al.

Science fare: A Practical Guide for Parents and Students. Markham, Ont.: Sciencefare Press, Inc., 1988. 0-201-50043-4. 63 pgs. A colourful guidebook written for students in grades 4 to 10 who want to explore science by creating a science project. Instructions help them to research, organize, measure, design, problem-solve, trouble-shoot, analyze, report and present. Step-by-step instructions include the getting-started phase of creating flow charts and timelines, choosing and researching a topic, planning experimental or non-experimental topics, doing an experiment and keeping records, wrap up and summary, building the exhibit for the fair, evaluation and judging procedures. Checklists throughout assist the student. Illustrations depict active female and male learners. Clearly written. References.
(A-W) (FWTAO/372.3 Con)

De Vito, Alfred, and Gerald H. Krockover.

***Creative Sciencing: Ideas and Activities for Teachers and Children.* Grades K - 8.** Glenview, Illinois: Good Year Books. Scott, Foresman and Company, 1990. 0-673-52008-0. 306 pgs. The 129 activities in this third edition of *Creative Sciencing* will be a valuable addition to an elementary science methods course, providing a comprehensive source of ideas and activities for use in the classroom. The subject areas cover biology, chemistry, earth sciences, environmental science, and physics. The skills range from analyzing motion to graphing to measuring to interpreting data. The activities are introduced as units, independent of others, and can be tailored according to the needs of the teacher and students. They are also written to act as a spring board for additional activities and are cross-referenced according to the processes of science and the content area covered. A "shoestring science" section deals with doing more science for less money. The language is gender neutral and the enlarged format provides easy readability.

Fraser, Sherry.

S.P.A.C.E.S. Solving Problems of Access to Careers in Engineering and Science. Illustrated by W. S. Wells. Palo Alto, California: Dale Seymour Publications, 1982. 0-86651-147-4.141 pgs. Spiral bound. A collection of math and career activities for students in grades 4 through 10. The exercises are designed to stimulate students' thinking about scientific careers, develop problem-solving skills, promote positive attitudes towards the study of math, increase interest and knowledge about scientific work, strengthen spatial visualization skills, and introduce language and familiarity with mechanical tools. Women's participation in science is emphasized (a women-scientist card game is included). Introductions for each activity define the skill, time needed, participants (groups or individuals), materials needed, preparation and directions. Extensions and work sheets are supplied.

(Eq) (Minkler/W.S. 371.42 Spa; OISE/C.R. 371.42 S732)

Hamilton Board of Education.

Science Kinder Mucking. Hamilton: Science Supervisor, the Board of Education for the City of Hamilton. 30 pgs. Spiral bound. French and English text. This bilingual resource guide provides junior and senior kindergarten teachers with activity centred ideas and materials to support the "beginnings" curriculum. A series of science kits accompanies the exercises. Each activity includes materials supplied in the kits, experiments to do, concepts learned, discussion topics, and teaching tips. Subjects cover colour, guck, looking and experimenting with gadgets, colour wheels, axles and wheels, life of organisms, smells, magnets, and touching different textures. Both girls and boys are illustrated as active learners.

Hargrave, Enid, and Janet Brooks.

Science Through Infant Topics. Teachers' Book A. General editor Brenda Prestt. London: Longman Scienceworld Series, Longman Group Limited, 1987. 0-58218-610-2. 150 pgs. The scientific exercises in this guidebook are designed for the 5- to 8-year-old student. The key skills learned are observing, communicating, measuring, recording, classifying, predicting, controlling variables, investigating. There are twelve activities to cover a full year. Each one takes place in a specific setting: a fall market, a gymnasium, around a Christmas tree, in a workshop. Discussions about the people and their occupations and activities enable science and related activities to be seen as an essential part of people's lives. Topics include seeds and growth seasons; forces and energy in physical exercise; observation, combinations, sorting, textures and colours; nails and screws, wood and metal. Diagrams set out the main objectives of each scientific experiment, list materials needed, and describe the presentation of the activity. The participation of the children is integral to the exercises themselves. Lavishly illustrated; female and male children are portrayed as active learners. Resources. Index.

(CCP) (OISE/C.R. 500 H279LT.b.a.)

Hargrave, Enid, and Janet Brooks.

Science Through Infant Topics. Starter Book A. (To be used with Teachers' Book A.) General editor Brenda Prestt. London: Longman Scienceworld Series, Longman Group Limited, 1986. 0-582 18-819-9. 32 pgs. This oversized display book functions as a tabletop flipchart and accompanies lessons in Teachers' Book A above. The colourful illustrations depict the people involved in the twelve different activities and provides a focal point for each lesson. Discussion points are located on the reverse side of the illustration that assist the teacher in initiating an exploration of occupations and starting the scientific experiments.

(CCP) (OISE/C.R. 500 H279L S.b.a.)

Heller, M., M.-E. Campbell, F. Pelletier, and A. Tremblay.

L'accès des élèves franco-ontariens à la formation postsecondaire et aux carrières non traditionelles. Toronto: Centre de recherches en éducation franco-ontarienne, 1987. This is an 8-volume publication addressing the issue of Franco-Ontarian students in science and technology. The work is designed as intervention material to influence career choices and educate students about the technological and scientific transformation of Canadian society. It is useful to career counsellors in the intermediate and secondary levels, and can be used by teachers. Vol. 1: focuses on orientation toward non-traditional work and how youth can be influenced. Extensive bibliographies and resource materials. Vol. 2 through 7 are activities: creating a fantasy about living in the future and the type of work the student might be doing; exploring job categories and writing profiles of careers in the fields of biology, chemistry, mathematics, physics, technology; preparing and conducting interviews with professionals; researching and organizing a debate about technological evolution and its impact; comparative studies of male and female representation in the work force and of the underrepresentation of Franco-Ontarians; examining the role sexual stereotyping plays in career choices. Each activity is outlined, provides goals, instructions, resources and worksheets, and lesson organisation. The final volume summarizes the activities and their purpose.

(see below) (OISE/Ref. 370.19342 A169)

Heller, Monica, and Mary-Ellen Campbell.

L'accèss aux études postsecondaires et aux carrières nontraditionnelles. Trousse d'orientation pour les niveaux intermédiaire et supérieur. Ottawa: Centre franco-ontarien des resources pédagogiques, 1988. 258 pg. This resource kit is a new edition of the one cited above. The focus and contents remain the same. Additions include film and video resources, a bibliography, and personnel resources. The activities are presented separately from the instructions and overviews. The entire kit is in a binder.

(CFORP)

Hocking, Colin, Jacqueline Barber, and Jan Coonrod.

Acid Rain - Teacher's Guide. Berkeley, California: Great Explorations in Math and Science (GEMS), Lawrence Hall of Science, 1990. 0-912511-74-5. 159 pgs. Illustrated. Students in Grades 6 to 10 are encouraged to feel engaged and

empowered, rather than discouraged and overwhelmed, through the exercises in this guide. Together they explore solutions and practice making cooperative decisions to solve the problems associated with acid rain. Emphasis is on having students brainstorm solutions and a variety of activity formats is included: lab experiments, discussions, writing, role playing, games, a town meeting, and a play. The eight sessions begin with finding out from the students what they know about acid rain. An experiment is set up to observe the effect of common acid on seed germination and is monitored throughout the sessions. Other exercises include how to measure the strenghts of acids and experimenting with the pH contents of a model lake. Each unit provides preparation and class time, an overview, materials needed, step-by-step instructions, discussion questions, and a homework assignment. Summary outlines are provided in the Appendices, as well as a list of Resources.

Hocking, Colin, Cary Sneider, John Erickson, and Richard Golden.
Global Warming & The Greenhouse Effect. Berkeley, California: Great Explorations in Math and Science (GEMS), Lawrence Hall of Science, 1990. 0-912511-75-3. 171 pgs. Illustrated. This workbook, suitable for Grades 7 to 10 and adaptable for advanced 6th Grade students, provides an opportunity for students to study global climate change in a supportive and constructive environment and is designed to help the educator communicate the basics about global warming and the greenhouse effect through a variety of laboratory activities, simulations and discussions. During the eight sessions, students improve their understanding of molecular model of heat, ways in which energy is transferred, how objects obtain a stable temperature, and the structure of the atmosphere. Each session provides an overview of the lesson, what materials are needed, preparation, step-by-step instructions, discussion questions, and a homework assignment. The first session is designed to find out what students know about the greenhouse effect, followed by a greenhouse experiment, a game to approximate the greenhouse effect, comparison of relative concentration of carbon dioxide in gas samples, social and ecological consequences of increasing heat, and worldwide effects of climate change. A summary outline of each session is provided in the Appendix as well as a list of Resources.

Massialas, Byron G. Project Director.
Fair Play: Developing Self-Concept and Decision-Making in the Middle School Decisions About Science. Student Guide. Newton, Mass.: Women's Educational Equity Act Program, 183. 130 pgs. The seventeen lessons in this workbook are designed for students in grades 6 to 9. The students explore their attitudes and beliefs about science, especially why males are more likely to pursue and succeed in this area than females. Through clearly written lessons they come to understand how genetic factors and natural and social environments have shaped these attitudes. Female role models demonstrate the work of electricians, astronauts, medical researchers, etc., and how technology and science affect individual life styles and life choices. Encourages constructive and co-operative decision-making skills. Illustrated.
(WEEA) (OISE/C.R. 305.3 M417F V.5)

Massialas, Byron, G. Project Director.

Fair Play: Developing Self-Concept and Decision-Making Skills in the Middle School: Decisions About Science. Teacher's Guide. Newton, Mass.: Women's Educational Equity Act, 1983. 139 pgs. The guide provides an overview for each lesson which includes duration of class, purpose, student objective, teaching suggestions, vocabulary learned, background information, and special preparations if necessary. Answers to the questions are included in each exercise and activities are suggested for students, especially female students, that challenge the belief that science is a male domain. Print and audio-visual resources. Illustrated.

(WEEA) (OISE/C.R. 305.3 M417F V.5 T.G.)

McClintock Collective.

Getting Into Gear. Gender Inclusive Teaching Strategies in Science. Canberra, Australia: Developed by the McClintock Collective, Curriculum Development Centre, 1988. 274 pgs. This book is a practical teacher resource containing curriculum materials and perspectives for upper elementary and secondary school science. The first of two major sections outlines the rationale for inclusive science teaching and explains many teaching strategies, classroom ideas and hints to develop inclusive science curriculum and assessment practices. The second section translates these strategies into practice providing many examples of creative and activity-based units. Units include Tinkering and Machines, Metal Magic and Women of Steel. Some activities look at the media while others use drama to teach electricity and chemistry. Each theory section contains references. Extensive resource guide.

(McC) (OWD Resource Centre)

McIntyre, Margaret.

Early Childhood and Science. Washington, D.C.: National Science Teachers Association, 1984. 0-87355-029-3. 136 pgs. A teacher's guidebook drawn from a series of the author's articles published in *Science and Children.* Topics cover colour awareness, sounds, spatial concepts, discovery and exploration, seasonal science activities, water and air, machines, and geology. Treats males and females equally and emphasizes needs of disabled children. Illustrated.

(NSTA) (Minkler/372.35044 Mcl)

Menard, Sharon L.

How High the Sky? How Far the Moon? Women Scientists Today. An Educational Program for Girls and Women in Math and Science. Washington, D.C.: Women's Educational Equity Act Program, 1980. 148 pgs. Microfiche. This packet of resource materials contains four sections: curriculum activities, a career guide for women, a role models list, and an annotated bibliography. The focus is women in science and mathematics. There are twenty-two activities for use at K-12 levels which cover mathematical procedures, classification of data and graphing methods, logic and procedures, spatial relationships, and mechanical aptitude. Self-awareness and job-hunting skills are emphasized. The Career Guide describes

careers in selected areas of science and math. Role models include Nobel Prize winners, prominent Black women scientists, and inventors.
(WEEA) (OISE/Eric 191 669)

Metropolitan Toronto School Boards.

Resource Documents for Science. Toronto: The Metropolitan Toronto School Board, 1986-1988. 5 vols. These curriculum materials were especially designed to have Toronto-wide applicability and have been written to the specifications of the Ministry of Education. There are five separate volumes of documents covering science coursework for grades 7, 8, 9, 10 general, and 10 advanced. Each unit constitutes four-fifths of the coursework with the compulsory optional units included. The grade 7 and 8 units begin with an overview giving information about preparation, key idea, objectives, applications, societal implications, materials, teacher preparation, background information, student activities, integration/extension. Appendices of student activity worksheets that can be copied. Grades 9 and both 10 levels begin with a Unit Planning Summary - suggested sequence of topics, objectives, evaluation, suggested evaluation breakdown, materials list; each topic includes key idea, objectives, applications, societal implications, safety, materials, resources, notes to the teacher, suggested evaluation, student activities. Appendices contain student-ready materials that can be copied, teacher answers, and bibliography. The material has been reviewed for bias and stereotyping.
(PH) (Minkler/507.1 09713 541)

Noyce, Ruth, ed.

Comets Profiles. Career Oriented Modules to Explore Topics in Science. Vol. 1. Illustrated by Jeannot Seymour. Washington, D.C.: National Science Teachers Association, 1984. 273 pgs. Spiral bound. This book of profiles accompanies the instructional modules of *Comets Science* (see "Smith, Walter" below) and provides biographies of contemporary women active in related scientific professions. Its two-fold purpose is to demonstrate to early adolescent females that learning math and science concepts can have a payoff in a wide variety of careers, and to encourage them to consider science-related careers. The biographies are set up as interviews so that the women in profile — a basketball coach, chemical engineer, physician, zoo administrator — actively speak about their profession. Each biography includes a content quiz, words to know, ideas for writing, and ideas for projects. Bios and/or activities may be copied for classroom activities.
(NTSA) (OISE/C.R. 507 C732 v.1)

Richards, Roy, Margaret Collis, and Doug Kincaid.

An Early Start to Science. London: Macdonald and Company (Publishers) Ltd., 1987. 0-356-115550. 80 pgs. A beautifully illustrated, easy-to-use book that offers a comprehensive collection of scientific experiences for 5- to 8-year-old children. The exercises encourage exploring, observing, manipulating, comparing, organizing, questioning, testing, and looking for patterns. All experiments are illustrated with straightforward directions listing materials needed. Topics explore the outlines of the body, shapes of noses and ears, feet and hands, music and

other sounds, gardens and gardening, colour, time, shadows, balancing, water, and electrical things. Male and female children are active learners.
(MacLon) (OISE/C.R. 507 R517E)

Scholastic Early Childhood Program: Science. New York: Scholastic Book Services, 1981. This multi-component boxed kit is designed to provide the foundation for a comprehensive kindergarten curriculum. The Science module contains a teaching guide, worksheets, assessment materials, a parent component, games, puzzles, learning posters (ocean and land), activity cards, sequence cards, colour/shape cards, baby/adult animal cards. The activities encourage the 5 year old to grasp ideas and learn a variety of tasks. Four themes cover thirty-two weeks of instruction: Same and Different, Needs and Feelings, Work and Play, Growth and Change. The 346-page teacher's guide is organized into weeks and lessons are organized by theme. Each lesson includes an objective, an overview of the week, and teaching activities which incorporate the program materials - worksheets, games and puzzles, etc. An appendix provides a resource list of books for children and teacher, audio-visual resources, and sources of information about children with special needs.
(o/p) (OISE/C.R. 500 S368)

Society for Women in Science and Technology.

Imagine the Possibilities: Girls in Science Workshop Activities for 9-12 Year Old Girls. Vancouver: Society for Women in Science and Technology, 1989. 133 pgs. Spiral bound. SCWIST designed these workshops to give girls a chance to have hands-on experience in a variety of activities involving physics, chemistry and biology. Using simple tools and getting their hands dirty, they have the pleasure of taking home a tuned up bike or newly crafted bird feeder, and gain the confidence to feel that it's OK for girls to plan careers in science and technology. The workbook has nine units, ranging from one and a half hours to three hours. Each unit describes the skills involved, materials and tools needed, instructions for setting up the unit, background information, extra exercises and games, and handouts. The topics include mechanics (bike basics), carpentry (bird feeder), concrete and non-traditional materials (flower pots), exploring electricity, experimental design and scientific equipment (ice cream maker), acids and bases, chemical reaction (kitchen chemistry), and photography (a pinhole camera).

Smith, Walter S. et al.

Comets Science. Career Oriented Modules to Explore Topics in Science. Vol. 2. Graphic designs and Illustrations by Michael G. Braa. Washington, D.C.: National Science Teachers Association, 1984. 447 pgs. Spiral bound. There are twenty-four sets of supplemental lesson plans for grades 5 to 9 in this module. It is designed to enable teachers to bring into their science or math class community resource people to (1) teach a captivating science lesson, (2)_tell students how the science concept being demonstrated is used in their career, and (3) talk with students and answer questions about their career. The action provides an example of a "living" science that is aimed to encourage students to keep the doors open to their future careers. Although *Comets* is designed to assist the resource visitors,

the activities can be led by the teachers. The lessons, divided into Physical Science and Engineering, Life Science and Health, Math, Calculating and Computers, identify the topic and suggest resource people and where to find them; outline the activities in the lesson; identify related modules; describe science contributions made by women in the field; include an extension activity, career information, and a bibliography of related activities, biographies and readings.
(NTSA) (OISE/C.R. 507 C732 V2)

Sprung, Barbara, Merle Froschl, and Patricia B. Campbell.
What Will Happen If...Young Children and the Scientific Method. New York: Women's Educational Equity Act, 1985. 0-931-62909-0. 128 pgs. With the help of this guide teachers are able to ensure that all children, regardless of sex, race or disability, develop essential math and science skills. Emphasis is placed on visual-spatial and problem-solving activities. There are four areas of exploration: water and sand, blocks, bottles and liquids, and machines. Each chapter includes an overview, step-by- step activities, materials needed and equity issues to be aware of while children perform the exercises. Designed for children between the ages of 4 and 6. Resources. References. Illustrated with photographs.
(WEEA) (FWTAO/372.7 Spr)

Women Inventors Project.
Interactive Poster Kit. Etobicoke, Ontario: Women's Inventors Project, forthcoming fall/winter 1992. Designed to represent a more well-rounded and accurate profile of Canada's scientific community, the poster will depict at least twenty female inventors, entrepreneurs, and scientists of varied ethnic and geographic backgrounds and from different eras in Canada's history. The kit will also feature several other interactive components, including a computer database containing information about 150 scientists and innovators, plus computer games and creative research tools. For those without computers, the kit will also contain a "hard copy" manual profiling the same 150 women, plus puzzles, trivia, and games. A portable exhibit will complete the package. The positive portrayal of women working in non-traditional occupations is intended to encourage girls and young women to pursue careers in science and technology.

Computers and Technology
Background Materials

Braid, Kate.

Looking Ahead: Profiles of Two Canadian Women in Trades/Prédire L'Avenir: Deux Femmes Canadiennes Racontent Leurs Métiers. Ottawa: Labour Canada, Women's Bureau (nd). 19 pgs. The two women profiled in this publication work as a plumber and a painter. The publication is intended to provide role models for others considering non-traditional work, and complements Labour Canada's publication *Building the Future: Profiles of Canadian Women in the Trades*, which features the stories of tradeswomen in welding, cabinetmaking, and carpentry.

Braundy, Marcia.

Orientation to Trades and Technology: a Curriculum Guide and Resource Book with Special Emphasis on the Needs of Women. Province of British Columbia, Ministry of Advanced Education and Job Training, 1987. 232 pgs. Designed for instructors conducting courses for women entering trades and technology, this guide can also be used with a wide range of learners regardless of their gender, age or status. Its purpose is to assist instructors in developing hands-on orientation programs to trades and technology that will help participants develop life skills and career planning capabilities, introduce them to a wide variety of occupations and give them a realistic understanding of what is required for working in these fields. There are three sections: a program overview which gives the purpose, rationale and goals of the curriculum program; practical information on how to use the guide; and course units. Course units include life skills, work-related skills and career development, and are sub-divided into sections and topic areas. Each topic area has a general introduction identifying the purpose, requirements and key ideas. Resources follow each unit and include handouts, background information, publications, films and videos.

Braundy, Marcia, ed.

Surviving and Thriving: Women in Trades & Technology and Employment Equity. **Proceedings of a Conference held October 1-4, 1988, at Naramata, B.C.** Winlaw, BC: Kootenay Women In Trades and Technology Association, 1989. 0-9694105. 265 pgs. Spiral bound. This book presents the edited transcripts of the most interesting and timely workshops held at the National Conference on Women in Trades and Technology. The information, insights and perspectives in this book make it a useful text for pre-trades and pre-technology courses for women, providing essential background knowledge for instructors and practical approaches for employers, employment equity practitioners and others concerned with these issues. The volume is presented in three key sections: 1) women in trades and technology which focuses on women's experiences in the field, discussions on gender difference in work and communication, sexual harassment, and educational programs and strategies; 2) employment equity looks at implementation, contract language and union seniority, affirmative action plans, equity in unionized workplaces, and training incentives; 3) women and technology

focuses on math anxiety and strategies for eliminating and controlling it, gender stereotyping in mathematics and sciences, strategies for encouraging girls into science and technology, gender discrimination, and an overview of the Women Inventors Project. Each section includes a keynote address. Recommendations on training, apprenticeship, sexual and gender harassment, unions, health and safety issues.

Brooks, Wilson et al.

Equitable Learning with Computers Now. Toronto: Board of Education for the City of Toronto, March 1987. 15 pgs. This document recommends numerous strategies designed to close economic, racial and gender-related gaps in computer use and to promote equality of computer access and learning. The strategies, directed towards classroom teachers and administrative staff, highlight equal access, software selection, and classroom management. Each strategy suggests concrete, immediate and practical actions and refers to specific publications that can facilitate its implementation.

(Phcopy/THE) (Minkler/004.07 09713541 Lea Suppl; TBE/LB1 028.43 .E654 1987)

Cherry, Frances, Nancy McIntyre, and Deborah Jaggernathsingh.

"The Experience of Canadian Women in Trades and Technology." ***Women's Studies International Forum*** 14 (1991):15-26. This paper reports on several aspects of a large-scale survey and interview study of Canadian women in trades and technology. The research involved 923 women either employed or in training in the field and concluded that career paths to non-traditional blue-collar work are both diverse and not predictable. Profiles of a selection of women in training provide personal backgrounds, educational and job-related histories, support received for their non-traditional choices, and experiences in training for and working in technology and the trades.

Chiarelli, Diana L

"Sex and Computers: Equity vs Inequity." ***Comment on Education*** February 1988):12-19. This article discusses the implication for girls in the use of computers and computer equity. In an effort to determine when sex typing of technology first occurs, the author reviews and critiques an American study which surveys computer- related attitudes, and compares it with a Canadian master's thesis "Gender Equity and Computer Use in the Classroom" by Betsy McKelvey. While the American study bases its research on the assumption that technology is a male world, McKelvey's study creates a framework for studying sex inequity and use of computers and suggests that teachers can be responsible for creating sex equity in the classroom. References.

(CE) (Minkler/Journals)

Collis, Betty.

"Adolescent Females and Computers: Real and Perceived Barriers." ***In Women and Education. A Canadian Perspective.*** ed. Jane Gaskell and Arlene McLaren, 117-131. Calgary: Detselig Enterprises Limited, 1987. The authors document the

difference between male and female computer usage and access by looking at such factors as gender differences in school participation (in B.C., Alberta and Ontario) and computer science at the secondary level, extracurricular usage and attitudes. They present a conceptual model that describes some of the barriers, both external and self-generated that underlie the situation: school-related policies and practices, social expectations, personal factors. References.
(DET) (OISE/376.971 W872)

Craig, Arlene Fong, et al.
"Debugging the Program": *Computer Equity Strategies for the Classroom Teacher.* Washington, D.C: Project on Equal Education Rights, NOW Legal Defense Fund, 1986. The major component of this kit is "Debugging the Program," a 29-page guide designed for the teacher. It includes a variety of strategies and activities which have been excerpted from other works. The strategies provide hands-on, effective pragmatic ways for the teacher to "debug" their computer education program and ensure equity for girls and young women, including women and girls of colour, and women and girls with disabilities. The strategies cover Teacher/Parent, Teacher/Community, and Curriculum/Special Events, and outlines the Minority Computer Resource Opportunity program which focuses on encouraging girls through personal counselling, encouraging computer equitability during class time and free time, and encouraging parental support. The activities are exercises in co-operative logic: co-operative effort among members of the student group is necessary since each students' clue is essential to the eventual solution of the problem. In conclusion, a discussion about *Pathways*, an applications- based software package which introduces computer education to children in grades 4 through 7. The second component of the kit is the Spring 1986 *PEER Computer Equity Report "Beyond the Star Trek Syndrome: To an Egalitarian Future"* which discusses the importance of equity and access in the schools to prepare women for the future.
(PEER) (OISE/C.R. 004.07 D289)

"Computer Equity." Special Issue. Edited by Sharon Franklin. **The Computing Teacher: The Journal of the International Council for Computers in Education** 11 (April 1984). 72 pgs. The emphasis of this issue is on promoting and achieving computer equity throughout the educational system. Articles by researchers and educators in the field include topics such as inequities in opportunities for computer literacy that affect adolescent and teenage females, minority and low-income students; strategies for achieving sex equity and practical solutions for teachers to help increase females' use of computers; identifying equitable software and encouraging females into computer programming; a report of a pilot project that helped grade 7 to 9 students improve their computer skills in an equitable learning environment; and ways to increase female students' access to technology. Each article is referenced.
(CT) (OISE/Journals)

Fancher, Evelyn.

"Educational Technology. A Black Perspective." Unpublished paper. (1983)10 pgs. Microfiche. The author argues that the learning of new technology cannot be left up to students to learn at their own pace. Negative self- image of Black youth obstructs their learning progress and if teachers hold stereotyped beliefs that Black youth are "lazy and unproductive," the student may be seen as "uninterested" when in fact she is in need of assistance. Technological instruction must be equally applied and encourage teacher-student interaction. Black youth need the application of educational technology deliberately developed to counteract the negative racial images that permeate mass media and influence their self-image. References.

(Phcopy/OISE or EricDoc) (OISE/Eric 240 213)

Franklin, Ursula Martius.

Will Women Change Technology or will Technology Change Women?/Les femmes changeront-elles la technologie ou la technologie changera-t-elle les femmes? Ottawa: Canadian Research Institute for the Advancement of Women, 1985. 46 pgs. It is important that women understand the dynamics and functionings of the technological systems we live in today in order to "fashion a web of life that is intrinsically human." The author compares the values and attributes of the technological system with those of the world of women — rigidity vs flexibility, efficiency vs spontaneity — and questions how women will adapt their technological literacy to a still male-dominated world. She urges women to understand the technological structure, to work in community with one another and to undertake research projects that will promote a constructive technological evolution.

(CRIAW) (OISE/305.40971 C928)

Government of Ontario. Ministry of Skills Development.

Apprenticeship: A New View of the Future. Counsellor's Handbook/Apprentissage: Une nouvelle vision de l'avenir, guide du conseiller d'orientation. Toronto: Government of Ontario, Ministry of Skills Development, 1989. Eng. 80 pgs./French 87 pgs. This handbook is designed to help vocational counsellors encourage females students into apprenticeship courses when it appears to be a visible career choice for them. Within the four chapters the counsellor is given information about marketing the skilled occupations to girls and women; non-biased techniques to assist young women explore their interests; an overview of the apprenticeship programs in Ontario and ways to help students prepare for interviews; and a directory of resources which lists federal and provincial training programs, films and videos, libraries, publications, and speakers and mentors. It is recommended that this handbook be used with its companion document *Apprenticeship: For Careers with a Future.*

Government of Ontario. Ministry of Skills Development.

Apprenticeship: For Careers with a Future/Apprentissage: Carrières d'avenir. Toronto: Government of Ontario, Ministry of Skills Development (nd). Eng. 146 pgs./French 150 pgs. This well-organized book outlines fifty-seven non-traditional occupations. Arranged alphabetically, each occupation lists what the career involves, advantages and disadvantages of doing the work, schooling and character traits required of the prospective apprentice, and various things the apprentice will have to learn in school and on the job. As well, pay ranges, the length of the apprenticeship program and the training required are given. Provides a good overview of what the apprentice may expect from her career choice.

James, Carol, and Jane Young.

"Case Study: Equal Opportunities through the Hertfordshire TVEI Project." In ***Changing Perspectives on Gender: New Initiatives in Secondary Education,*** ed. Helen Burchell and Val Millman. Milton Keyes, England: Open University Press, 1989, 14-32. The Technical and Vocational Education Initiative project in Hertfordshire, England, is an on-going program designed to support the development of full-time, general and vocational education for 14- to 18-year-old students. Course options include manufactory technology, computer studies, modular technology, electronic instrumentation, information technology, office technology and communications. The authors report on the progress, plans and activities of the program to meet an equal opportunities mandate, they describe the difficulties of attracting girls and implementing equal opportunity strategies, the organisation and effect of workshops, and staff and curriculum development.
(OpenU) (OISE/370.19345 C456)

Moore, Barbara G.

Equity in Education. Gender Issues in the Use of Computers. A Review and Bibliography. Toronto: Queen's Printer for Ontario, 1986. 68 pgs. This is a review of research done in Canada which tends to reach similar finding to that done in the U.S., Australia and England: there are differences between males and females in access to, attitudes towards, and use of computers at the intermediate and high school levels. The author documents research that looks at the reasons why males are getting more computer time than females; the belief by females that computers involve use of mathematical concepts; why a high percentage of programming courses are generally avoided by females; the social context of classrooms; software; influence of parents; influence of role models. She provides suggestions to counter these patterns. Annotated bibliography and current research inventory.
(ONME) (TBE/LB5.R4 V.6 no. 1; OISE/370.9713 R454 V.6 no. 1)

Pelletier, Jacqueline, ed.

'The Future is Now": Women and the impact of Microtechnology << L'avenir se décide maintenant >> Les femmes et l'impact de la microélectronique. Report on the Conference held in Ottawa, June 1982. Ottawa: Women and Technology Committee, 1983. 148 pgs. Eng./150 pgs. French. This bilingual edition documents the groundbreaking conference sponsored by four national women's organizations to discuss women's roles in Canada's future technological

society. The conference was structured around five themes —changing employment patterns, health and safety, education, training and retraining, and information access and control. Of special interest is the Education section. The keynote speaker, Mary Beth Dolin, MLA Manitoba, addresses affirmative action for girls in science and especially computer science education, discusses microcomputer pilot projects in two of Manitoba's elementary and secondary level schools, and provides an overview of Canadian women's place in a technological society. Seven workshops are outlined and conclude with specific actions that can be taken.

(CRIAW) (OISE/303.4834 R425 and Women's Resource Centre)

Project on Equal Education Rights.

Black Women in a High Tech World: A New Frontier. PEER Report No. 3, 1982. Washington, D.C.: Project on Equal Education Rights, 1982. 5 pgs. How can Black women prepare to take advantage of the future technological opportunities and protect themselves from obsolescence? Statistical information from the early 1980s indicates that a very small percentage of Black women are in the occupations which will be in demand in the future. The report looks at educational barriers and advises the necessity of encouraging Black female high school students to study mathematics and science. One step in this direction is the provision of sound career counselling to prepare students for technical jobs.

(PEER or Phcopy/OISE) (OISE/Eric 263 262)

Project on Equal Education Rights.

Programming Equity into Computer Education. Today's Guide to the Schools of the Future. A PEER Computer Equity Action Kit. Washington, D.C.: The National Centre for Computer Equity of the Project on Equal Education, 1985. This kit contains three components: a *Teacher's Guide*, a *PEER Computer Equity Report*, and an information pamphlet about the Project on Equal Education Rights. The 36-page *Teacher's Guide* provides an assessment for teachers, parents, administrators and students who want to find out which "schools support and encourage girls, minority students, students with disabilities, and low-income students to participate in computer education." Included are interview questions. Concrete and achievable strategies to direct change are outlined. The *PEER Computer Equity Report* discusses basic aspects of computer inequity: unequal access to programming classes, unequal distribution of computer resources, lack of confidence and skills, and the role of teachers in closing the gender gap.

(PEER) (OISE/C.R. 004 P964 and Eric 260 014)

Schubert, Jane G. and others.

Ideas for Equitable Computer Learning. Palo Alto, California: American Institute for Research in the Behavioral Sciences, 1984. 76 pgs. Microfiche. This packet of information focuses on the twelve major barriers which obstruct equitable instruction. Among those identified are the lack of encouragement for females and minority students to use computers, potential value of computer learning is more apparent to males than females; underrepresentation of females and minorities in computer clubs; underrepresentation of females and minorities

in leadership roles. Each barrier is addressed through an activity which describes a problem situation that constructs a barrier, illustrates an actual situation, provides awareness activities and ideas for interventions, and concludes with an assessment of the actions for interventions. Additional documents in the kit include a student survey, an educator's self-assessment, early childhood computer readiness strategies directed to teachers of grades K-3, and an out-of-school computer access resource that offers practical ways for schools to foster equity in students' non-school computer experience. Problems and strategies may have more practical use in primary and junior high school settings but some suggestions may be useful for K-3 class activities.
(AIR) (OISE/Eric 272 138)

Tashner, John H., ed.
Computer Literacy for Teachers: Issues, Questions, and Concerns. Phoenix, Arizona: The Oryx Press, 1984. 0-89774-196-X. 150 pgs. The primary goal of this guidebook is to assist professional educators in gaining a clear understanding of the impact that computer technology is having in the schools and the skills children need in order to function in the Information Society. There are three main sections: the relationship between the developing information society and the K-12 school curriculum; what teachers should teach students about computers in order to prepare them for the Information Age; and how other schools have designed programs to meet this challenge. Each section consists of articles selected from a comprehensive study and analysis of literature dealing with computer literacy programs in education and includes an annotated bibliography of recommended readings.
(Oryx) (OISE/371.39445 C7389; Minkler/371.39445 Comm Lit)

Wahl, Ellen.
"Girls and Technology: Stories of Tools and Power." Paper presented at the Annual Meeting of the American Educational Research Association symposium on "Women and Technology: New Perspectives on Design and Use." New Orleans, La., April 8, 1988. 11 pgs. Microfiche. "Given the opportunity to explore machines, use tools, take things apart, get their hands dirty and their minds engaged, girls transform technology from a male domain into one over which they can have control." The Operation SMART program for out-of-school technology activities provides girls with hands-on experience at using power tools, screw drivers, computers, and video equipment. In addition, they discuss connections between gender stereotyping and scientific pursuit and demystify the workings of a machine. The paper outlines methods of learning through sharing and collaboration which encourage self- confidence and self-reliance.
(Phcopy/OISE or EricDoc) (OISE/Eric 302 402)

"Women, Girls and Computers." Special Issue. Marlaine E. Lockheed, ed. *Sex Roles: A Journal of Research* 13 (August 1985). The eleven articles in this issue "present the first empirical evidence regarding the determinants and cognitive consequences of sex-related differences in computer use by adults and children." Topics include teachers as role models and leaders, computers and girls, software

programs and the organization of learning in the classroom, male and female enrolment in computer camps and classes, and fostering equitable consequences from computer learning environments. Each article is referenced.
(SR) (OISE/Journals)

Bitter, Gary, and Donna Craighead.

Teaching Computer Literacy. Lesson Plans and Activities for Your Classroom (K-4) Austin, Texas: Sterling Swift Publications, 1984. 0-88408-325-X. 317 pgs. Published in a looseleaf binder, this workbook offers thirty-four topics for kindergarten to grade 4 students. Lessons are planned for progressive learning. Basic concepts are introduced to kindergarten children who use the computer following directions, programming devices and using the turtle graphics to make simple shapes. Keyboarding and turtle graphics are main components of first grade learners. Second grade lessons introduce students to the effect computers have on their lives, continued explorations of turtle graphics and an introduction to LOGO procedures. The logic of computers and continued work with Logo are 3rd grade subjects, and 4th grade students are introduced to hardware and software, binary numbers, flow charts, and storyboarding. There are five extensive lesson plans for each introductory activity. Each lesson plan identifies the topic, objective, curriculum area(s), time required, materials required, activity, and whether or not a computer is needed. Vocabulary accompanies each chapter of lessons. References.

(SSP) (OISE/C.R. 004 B624T)

Clements, Douglas H.

Computers in Early and Primary Education. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1985. 0-13-164013-5. 322 pgs. A practical book of guidelines for educators of young children in preschool, kindergarten, and Grades I through 3. Demonstrates how computers can be used with young learners and describes programs for young children. Each chapter includes an annotated bibliography. Glossary. References. Appendix of educational software, organizations and print resources. Index.

(PH) (OISE/372.139445 C626C; TBE/LB1028.5 .C5254 1985; FWTAO/001.64 CLE)

Collis, Betty.

Computers, Curriculum and Whole-Class Instruction. Issues and Ideas. Belmont, California: Wadsworth Publishing Co., 1988. 0-534-08460-5. 412 pgs. with an Activities Disk. The author is a contributing editor to *The Computing Teacher*. This book is for educators interested in teaching with computers and is organized by lesson plans which are categorized by subject area and grade level. Each lesson plan relates to specific curricular objectives and can be utilized in a whole-class setting when only one computer is available. The Activities Disk includes twenty programs providing immediate hands-on experience. Science is covered in two of the chapters with activities for grades 2 to 12. They present simulations, graphing, manipulation of data, using peripherals to collect data, using a data base. Mathematics is covered in three chapters and presents lessons for grades 1 through 11 . Elementary arithmetic, and secondary mathematics - parallelograms, polygons, linear inequalities, problem-solving skills. Each lesson specifies equipment requirements, lesson description and includes follow-up

activities. References. Appendices describe programs supplied on the disk and provide two detailed lesson plans with several worksheet samples.
(NEL) (Minkler/371.39445 Col)

Douziech, Richard et al. Ed. Anita Best.
Computer Literacy Activities for Elementary and Middle School Students. International Council for Computers in Education, 1983. 0-924667-02-8. 56 pgs. The emphasis of this book is the building of sound computer literacy among teachers and students. Computer literacy is more than the basic operation of a computer. It is knowing how to use computer-aided methods in problem solving, exploring music and mathematics, art and geometry, and understanding algorithmic processes, general capabilities and applications. The twelve activities address computer literacy, mathematics and science applications. Each activity outlines the subject covered, skills taught, group size, facilities, materials, and objectives. Glossary.
(ICCE) (OISE/C.R. 004 C738)

Girard, Suzanne, and Kathlene Willing.
The Primary Computer Dictionary. 50 Useful Words and Definitions to Introduce Young Children to Computers. Illustrated by Melanie Hayes. Cobalt, Ont.: Highway Bookshop, 1983. 55 pgs. An animated computer introduces fifty words to children from kindergarten to Grade 3. The words are selected from six general categories: general concepts, hardware, commands, programs, keys and language. One concept per page, clearly written, with a glossary of new words.
(HBS) (OISE/C.R. 001.6403 G518P)

Hunter, Beverly.
My Students Use Computers. Computer Literacy in the K-8 Curriculum. 1983. Reprint. Reston, Virginia: Reston Publishing Co., Inc., 1984. 376 pgs. Specifically designed to help any person who is concerned about the use of computers in the education of children in school in grades K through 8. The first three chapters address what the children need to learn about computers and information handling, how these new objectives fit into the curriculum in mathematics, science, and how to use computers in the classroom, what resources are needed. The balance of the book provides sample activities in the strands of mathematics and science. Each activity states the objective, prerequisite, materials needed, instructions for the teacher, related activity, and recommended readings.
(RPC) (OISE/372.139445 M995; Minkler/371.39445 Hun My; FWTAO/001.64 Hun)

McGinnis, Mary, and Jo Sanders.
"What is Computer Equity? A Trainer's Workshop Guide." Metuchen, N.J.: Women's Action Alliance, Inc. and The Scarecrow Press, Inc., 1991. 0-8108-2367-5. 159 pgs. and 134 templates. Looseleaf with 3-ring binder. The first of three publications developed to address computer equity for girls, this complete in-service workshop guide can be used by anyone who works with middle school students - classroom teachers, teacher aides, library or media centre personnel,

guidance personnel, and administrators. It can also be used at higher and lower grade levels with parent and community groups. Using the Guide, trainers are able to conduct a two and half-hour workshop to introduce educators to the "computer gender gap". In a varied series of activities, they learn where the computer gender gap can be seen, why it matters, what causes it, and how to overcome it. Each of the five sections include an Overview, Leading the Activity, Wrapping Up the Activity, and Possible Pitfalls. The instructor is guided step by step with questions and answers, discussion topics, key points, and research findings. The Templates for overhead transparencies and handouts are incorporated into each Activity. Resources.

McGinnis, Mary, and Jo Sanders.
"Computer Equity in Math and Science: A Trainer's Workshop Guide." Metuchen, N.J.: Women's Action Alliance, Inc. and The Scarecrow Press, Inc., 1991. 0-8108-2368-3. 133 pgs. with 36 templates. Looseleaf with 3-ring binder. This second publication in the Computer Equity series is a workshop guide for mathematics and science educators at all grade levels after they have had the first workshop, What Is Computer Equity? For use by a trainer or staff developer, the activities in this two and three-quarter hour workshop include learning about the underrepresentation of girls and women in mathematics and science study as a career, hands-on activities to identify sex-biased software equitably, and activities to ensure that teachers, parents, and peers support girls' computer involvement. The Guide is organized similarly to *What Is Computer Equity?*, leading the trainer step by step through each section. Templates and a resource section are included.

McGinnis, Mary, and Jo Sanders.
"Counting on Computer Equity: A Quick and Easy Guide for Finding Out If Your School has a Computer Gender Gap." Metuchen, N.J.: Women's Action Alliance, Inc. and The Scarecrow Press, Inc., 1991. 0-8108-2369-1. 14 pgs. This booklet completes the Computer Equity series and tells educators at all grade levels how to assess computer use and behaviour by sex in free-access time in school, elective course enrolments, required classroom computer use, computer use outside of school, and students' future plans involving computers. Suggestions are provided on resolving the computer gender gap problem once it has been identified.

Milone, Michael N. Jr.
Every Teacher's Guide to Word Processing. 101 Classroom Activities for Early Grades. Englewood Cliffs, N.Y.: Prentice-Hall, Inc., 1985. 013-292830-2. 260 pgs. Spiral bound. The twelve chapters of exercises cover all subject areas as well as some administrative tasks such as the keeping of class records. This book is for both the teacher just learning about computers and the more advanced instructor. The introduction outlines how to begin a word processing program, setting up files and provides a glossary of terms; the classroom exercises, which range from primary, elementary and secondary levels, include reading, writing and spelling, mathematics and science applications, and computer literacy.
(PH) (OISE/C.R. 371.39445 M661E)

Schenk, Christopher.

Hands On. Hands Off. A Computer Activity Book for Schools. London: A. & C. Black, 1986. 0-7136-2707-7. 120 pgs. Spiral bound. Most of the activities in this book are aimed at primary levels. Some can be adapted for kindergarten classes and others for older pupils in secondary schools. Hands-on activities, usually suitable for small groups of children working together at computers, and hands-off activities, things to do away from the computer, accompany each of the three sections. Topics include the computer as a versatile resource — calculator, teaching machines, wordprocessor; an introduction to Turtle Geometry and LOGO; and information retrieval and data processing. Illustrations of male and female children as active learners. Index.

(CMC) (OISE/C.R. 371.39445 S324H)

Sanders, Jo Shuchat and Antonia Stone.

The Neuter Computer: Computers for Girls and Boys. New York City: Neal-Schuman Publishers, Inc., 1986.1-55570-006-3. 279 pgs. This book is suitable for teachers working in middle and junior high schools, as well as elementary schools. The introduction provides an overview of the computer gender gap, guidelines for planning and evaluating a computer, equity programs in schools, and resources. The main three sections of the book are devoted to activities, strategies and evaluations. There are 56 computer activities specifically chosen for their appeal to girls and include subject areas in which computer application can be used. Topics include graphics, wordprocessing, database programs, spreadsheets, telecommunications. The 96 equity strategies are appropriate for teachers, staff, administrators and parents who want to increase girls' computer involvement from classroom to community. The third section suggests ways of planning and evaluating computer and equity programs - questionnaires and forms are included in the Appendix. Bibliography. Extensive resources.

(N-S) (TBE/QA76.27 .S26 1986)

Wayne, Rudy, Joe Vayda, and Marta Legrady.

Computer Literacy. An Introductory Unit for the Intermediate Division. Toronto: Learnxs Press, 1982. 86 pgs. Spiral bound. The information in this guidebook is to be integrated with existing curricula. There are two sections, each having activity units. Computer awareness and the complexity of our computerized society is the theme of the first section with exercises focusing on computer applications, digital computers, historical overview, and social implications. The second section provides students with activities designed to develop skills in microcomputer use and programming with BASIC. Hands-on activities include programming, calculating, and enrichment studies. Written in clear language. References.

(LP) (OISE/C.R. 001.64 W134C)

Willing, Kathleen, and Suzanne Girard.

The Junior Computer Dictionary: 101 Useful Words and Definitions to Introduce Students to Computer Technology. Illustrated by Melanie Hayes.

Cobalt, Ont.: Highway Bookshop, 1984. 0-88954-302-X. 68 pgs. The 101 illustrated entries are drawn from eight categories: general concepts, hardware, inner workings, commands, programs, keys, language and communications. An animated computer introduces the word and demonstrates its usage. The definition is clearly written in language suitable for grades 4 to 7. The dictionary encourages students to investigate terminology, is useful for parents at home and teachers in the classroom to introduce computer vocabulary. Glossary of new words.

(HBS) (FWTAO/001.64 Wil)

Distributor's Codes

AIR American Institutes for Research
Center for Educational Equity
P.O.Box 1113
Palo Alto, California 94302
(415) 493-3550

AMM American Mathematical Monthly
The Mathematical Association of America
1225 Connecticut Avenue N.W.
Washington, DC 20036

ATA Alberta Teachers' Association
11010-142 Street
Edmonton, Alberta T5N 2R1
(403) 453-2411

A-W Addison-Wesley Publishers Limited
26 Prince Andrew Place
P.O. Box 580
Don Mills, Ontario M3C 2T8
(416) 447-5101

BCEd B.C. Ministry of Education
7451 Elmbridge Way
Richmond, British Columbia V6X 1B8

CCP Copp Clark Pitman Ltd.
2775 Matheson Blvd. East
Mississauga, Ontario. L4W 4P7
(416) 238-6074

CCSD The Canadian Council on Social Development
55 Parkdale Avenue
P.O. Box 3505, Station C
Ottawa, Ontario. K1Y 4G1
(613) 728-1865

CFORP Centre franco-ontarien des resources pédagogiques
339, rue Wilbrod
Ottawa, Ontario K1N 6M4
(613) 238-7957

APPENDIX A

ChT Children Today
Room 348-F
200 Independence Avenue SW
Washington, D.C. 20201

COE Comment on Education
Department of Educational Administration
Faculty of Education
University of Toronto
371 Bloor Street West
Toronto, Ontario M5S 2R7

CMC Collier Macmillan Canada, Inc.
539 Collier Macmillan Dr.
Cambridge, Ontario N1R 5W9
(800) 265-8669/8674

CRIAW Canadian Research Institute for the Advancement of Women/Institut canadien de recherches sur les femmes
(CRIAW/ICREF)
480-151 Slater Street
Ottawa, Ontario K1P 5H3
(613) 563-0681 or 563-0682

CT The Computing Teacher
University of Oregon
1787 Agate St.
Eugene, Oregon 97403

CTF Canadian Teachers' Federation
110 Argyle Ave.
Ottawa, Ontario K2P 1B4
(613) 232-1505

CTY Cassell Tycooly Inc.
P.O. Box C-166
Riverton, New York 08077
(201) 939-6064

CWS Canadian Woman Studies/Les cahiers de la femme
(CWS/cf)
Suite 212 Founders College
York University
4700 Keele Street
Downsview, Ontario M3J 1P3
(416) 736-5356

DD Diffusion Dimedia
539, boul Lebeau
St. Laurent, Québec H4N 1S2
(514) 336-3941

DET Detselig Enterprises Ltd.
P.O. Box G 399
Calgary, Alberta T3A 2G3
(403) 283-0900

Eq EQUALS
Lawrence Hall of Science
University of California
Berkeley, California 94720

EricDoc Eric Documents
Provides photocopying of document or the microfiche/price catalogue available
Document Reproduction Service
3900 Wheeler Ave.
Alexandria, Virginia 22304-6409
(703) 823-0500

FP Falmer Press
c/o Taylor & Francis
1900 Frost Road
Suite 101
Bristol, Pennsylvania 19007
(215) 785-5800

FRK Franklin Watts of Canada
20 Torbay Rd.
Markham, Ontario L3R 1G6
(416) 474-0333

FWTAO Federation of Women Teachers' Associations of Ontario
1260 Bay Street
Toronto, Ontario M5R 2B8
(416) 964-1232

Gf La Gazette des femmes
8, rue Cook, 3e étage, bureau 300
Québec, Québec G1R 5J7
(418) 643-4326
(800) 463-2851

APPENDIX A

GREMF Group de recherche multidisciplinaire féministe
a/s de Huguette Dagenais
Département d'anthropologie
Faculté des science sociales
Pavillon Charles-De Koninck
Université LavalQuébec, Québec G1K 7P4

GQ Gouvernement du Québec
La Coordination à la condition féminine
Ministère de l'Éducation
1035, rue De La Chevrotière - 24e étage
Québec, Québec G1R 5A5
(418) 643-3241

HBS The Highway Book Shop
Cobalt, Ontario P0J 1C0
(705) 679-8375

ICCE International Council for Computers in Education
University of Oregon
1787 Agate Street
Eugene, Oregon 97403
(503) 686-4414

IJE International Journal of Educational Research
Pergamon Press
Journals Division
Maxwell House, Fairview House
Elmford, New York 10523

JEG Journal for the Education of the Gifted
The University of North Carolina Press
116 South Boundary Street
P.O. Box 2288
Chapel Hill, North Carolina 27515-2288

JHU The Johns Hopkins University Press
701 W 40th St.
Suite 275
Baltimore, Maryland 21211
(301) 338-6956

JRME Journal for Research in Mathematics Education
1906 Association Drive
Reston, Virginia 22091

LC Labour Canada
Ottawa, Ontario K1A 0J2 (819) 994-0543

LP Learnxs Press
155 College Street
Toronto, Ontario M5T 1P6
(416) 591-8178/9

LRU Longman Resources Unit
c/o ABC-CLIO, Inc.
2040 Alameda Padre Serra
P.O. Box 4397
Santa Barbara, California 93140-4397
(805) 963-4221

MacLon Macdonald & Co. (Publishers) Ltd.
Greater London House
Hampstead Road
London, United Kingdom NW1 72X

MC Math/ScienceNetwork
c/o Mills College
Oakland, California 94613
(415) 430-2230

McC The McClintock Collective
Hawthorn Professional Development Centre
11 Paterson St.
Hawthorn, Victoria 3122
Australia
Cost of both publications is $25.00 Canadian plus $10.00 postage/surface or $15.00 air mail

MethLon Methuen/London 49
Michelin House
81 Fulham Road
London,
United Kingdom SW3 6RB

MIT The MIT Press
55 Hayward St.
Cambridge, Maryland 02142
(617) 253-2884

MPS Minneapolis Public Schools Equal Education:
Student Achievement
807 NE Broadway
Minneapolis, Minnesota 55413
(612) 627-2143

APPENDIX A

MT Mathematics Teacher
1906 Association Drive
Reston, Virginia 22091

N/A Not Available

NAL North American Library Canada Ltd.
81 Mack Ave.
Scarborough, Ontario M1L 1M8
(416) 699-7193

NCTM National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

Nel Nelson Canada
1120 Birchmount Rd.
Scarborough, Ontario M1K 5G4
(416) 752-9100

N-S Neal-Schuman Pubs. Inc.
23 Leonard St.
New York, New York 10013
(212) 925-8650

NSTA National Science Teachers' Association
1742 Connecticut Ave. NW
Washington, D.C. 20009
(202) 328-5800

NWHP National Women's History Project
7738 Bell Road
Windsor, California 95492-8518
(707) 838-6000

NYBEc North York Board of Education
c/o Women's Studies
Education Curriculum
5050 Yonge Street
North York, Ontario M2N 5N8
(416) 225-4661

NYBE/Res North York Board of Education
c/o Research Department
5050 Yonge Street
North York, Ontario M2N 5N8
(416) 225-4461 ext 332

OERC Ontario Education Research Council
1260 Bay Street
Toronto, Ontario M5R 2B1

OISE OISE Press
The Ontario Institute for Studies in Education
252 Bloor Street West
Toronto, Ontario M5S 1V5
(416) 926-4723

OISE/TCP Teachers College Press
c/o OISE Press
The Ontario Institute for Stûdies in Education
252 Bloor Street West
Toronto, Ontario M5S 1V5
416-926-4723
Quote #B1227

OMG Ontario Mathematics Gazette
1 Southdale Drive
Markham, Ontario L3P 1J6

ONMe Ontario Ministry of Education
Publications Services
880 Bay Street, 5th Floor
Toronto, Ontario M7A 1N8
416-326-5300

o/p Out of Print

OpenU Open University Press
c/o Francis & Taylor
1900 Frost Road
Suite 101
Bristol, Pennsylvania 19007
215-785-5800

Oryx Oryx Press
2214 N. Central Ave.
Phoenix, Arizona 85004-1483
602-254-6156

PDK Phi Delta Kappan
Eighth & Union
P.O. Box 789
Bloomington, Indiana 47402

APPENDIX A

PEER Project on Equal Education Rights
1333 H St. N.W., 11th Floor
Washington, D.C. 20005
202-682-0940

PERG Pergamon Press Inc.
Order Department
Front and Brown Streets
Riverside, New Jersey USA 08075

PH Prentice-Hall Canada Inc.
1870 Birchmount Rd.
Scarborough, Ontario M1P 2J7
416-293-3621

Phcopy/CEMSAT It is permitted to photocopy this publication in its entirety.

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416-923-6641

Phcopy/TBE Individuals can photocopy in the Library
Toronto Board of Education
155 College Street
Toronto, Ontario M5T 1P6
416-591-8183

RCH Routledge Chapman Hall
29 West 35th Street
New York, New York 10001
212-244-3336

RFP Revue Française de Pédagogie
Institut National de Recherche Pédagogique
291, rue d'Ulm
75230 Paris Cedex 05

RFR Resources for Feminist Research/Documentation
sur la recherche féministe
The Ontario Institute for Studies in Education
252 Bloor Street West
Toronto, Ontario M5S 1V5

RPC Reston Publishing Co. Inc.
1906 Association Drive
Reston, Virginia 22091

RSTE Research in Science & Technological Education
Carfax Publishing Company
P.O. Box 25
Abingdon, Oxfordshire
United Kingdom OX14 3UE

SA Scientific American
415 Madison Avenue
New York, New York 10017

SCC Science Council of Canada
The Publications Office
100 Metcalfe St.
Ottawa, Ontario K1P 5M1

SCWIST Society for Canadian Women in Science & Technology
P.O. Box 2184
Vancouver, British Columbia V6B 3V7

SE Science Education
Subscription Department
John Wiley & Sons Inc.
605 Third Avenue
New York, New York 10158

SR Sex Roles Journal
Plenum Publishing
233 Spring Street
New York, New York 10013

SSE Studies in Science Education
Railway Cottages
Wansford Road
Driffield, East Yorkshire
United Kingdom Y025 0JL

SSP Sterling Swift Publications
7901 South IH-35
Austin, Texas 78744

Sou Sources
26 Hart Avenue
Hopewell, New Jersey 08525
609-466-0051

APPENDIX A

STA Software Training Associates
311-1020 McKenzie Avenue
Victoria, British Columbia V8X 3Y1
604-479-8220

TBEd/Math Toronto Board of Education
c/o Mathematics Department
155 College Street
Toronto, Ontario M5T 1P6
598-4931
*This publication is FREE to members of the Toronto Board of Education, and $10.00 to members outside of the Toronto Board of Education.

TBEd/Res Toronto Board of Education
Research Department
155 College Street
Toronto, Ontario M5T 1P6
598-4931

TBE/Sc Toronto Board of Education
c/o Science Department
155 College Street
Toronto, Ontario M5T 1P6
416-591-8256
*Cost of purchase to members and non-members $10.00

WEEA Women's Educational Equity Act Publishing Center
Education Development Center
55 Chapel Street, Suite 200
Newton, Maryland 02160
617-969-7100

WIP Women Inventors Project
22 King St. South
Waterloo, Ontario N2J 1N8
(519) 746-3443

WV Westview Press
5500 Central Ave.
Boulder, Colorado 80301
303-444-3541

Location Code
Libraries and Resource Centres

FWTAO
Federation of Women Teachers' Association of Ontario
1260 Bay Street
Toronto, Ontario M5R 2B8
416-964-1232

Hours: Phone to verify daily hours.

Open to: Members of FWTAO, affiliates, associates and individuals involved with FWTAO as student teachers and volunteers.

Minkler
The F.W. Minkler Library
Education Administration Centre
5050 Yonge Street
3rd Floor
North York, Ontario M2N 5N8
416-225-4661, ext. 554

Hours: Monday to Friday 8:00-5:00
After 5:00 call 229-5541

Open to: NYBE teachers have borrowing privileges and can photocopy materials at no cost. Non-NYBE visitors can use reference materials in the library and can photocopy materials at a small cost.

Special Call Number Codes:
Journals - Journal Collection
W.S. - Women's Studies

OISE
Ontario Institute for Studies in Education
2nd Floor
252 Bloor Street West
Toronto, Ontario M5S 1V5
416-923-6641

Hours: Fall-Winter: Monday-Thursday 8:30-10:00 p.m.
Friday 8:30-5:00 p.m.
Saturday 9:00-5:00 p.m.
Sunday 1:00-6:00 p.m.
Summer: Monday-Thursday 7:30-8:00 p.m.
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Open to: OISE faculty, staff and students Non-OISE members may purchase a borrowing card for $35.00/year.
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Eric	Eric Documents on Microfiche Collection
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OISE
Women's Resource Centre
Ontario Institute for Studies in Education
252 Bloor Street West
6th Floor
Toronto, Ontario M5S 1V5
416-923-6641, ext. 2244

Hours: Monday to Friday: 9:30-4:30
Thursday: 10:00-8:00
Open to: Membership is open to anyone at $2.00/year

Francophone Co-ordinator: Didi Khayatt
Thursdays: 10:00-8:00

OWD
Ontario Women's Directorate
Resource Centre
480 University Avenue
3rd Floor
Toronto, Ontario M5G 1V2
597-4591
Hours: Monday to Friday: 9:00-5:00
Open to: The general public for reference only.
Photocopy service: Available.

TBE
Toronto Board of Education
155 College Street
7th Floor
Toronto, Ontario M5T 1P6 416-591-8183

Hours: Monday to Thursday: 8:00-5:00
Friday: 8:00-4:30

Open to: Members of the Toronto Board of Education
Non-members are welcome to use library materials as in-library reference materials

Photocopy Service: 10¢ per page

Special Call Number Codes:
Journals - Journal Collection

APPENDIX C

VIDEOS

Catalogues

Gouvernement du Québec.

Soyez Également Branchés: Vidéos et films sur les carrières non-traditionnelles. Gouvernement du Québec, Ministère de l'éducation. This pamphlet lists thirteen films and videos dating from 1978 to 1985 that focus on women in non-traditional occupations. It also lists three distributors of the films located in Québec and Montréal.

National Film Board of Canada.

Beyond the Image: Films and Videos about Women's Culture, Politics and Values/Images de femmes. Third Edition. Montreal, Quebec: National Film Board of Canada, Women's Marketing D-5, 1991. 0-7722-0316-4. 102 pgs. This catalogue offers a selection of forty-two women and work videos and films. Included among them are films about women in non-traditional occupations. *In Attention: Women at Work/Femmes au travail* (1983) a hovercraft pilot, architect and journeywoman speak of their success in male-dominated work places; *Breaking Through* (1981) is a docudrama that provides an experimental look at pre-trades and technology for women. Other titles include *Head Start: Meeting the Computer Challenge* (1984), *I Want To Be An Engineer* (1983), and *She's A Railroader/Aiguilleuse au CN* (1978).

Videos

Industry, Science and Technology.

Rap-O-Matics/Rap-o-matiques. Ottawa: Industry, Science and Technology. 12 min. This video is designed to encourage secondary students to pursue their courses in mathematics and science throughout their secondary studies. An accompanying guide assists instructors in promoting the importance of mathematics and science in the students' work and career lives.

Labour Canada.

What About You?/À toi de choisir! 19 min. video. Ottawa: Labour Canada, the Women's Bureau, 1991. Profiles six women in non-traditional occupations, highlighting the training, work setting and aspirations of a pilot, a research scientist and manager, a television camera operator and producer, a firefighter, an aerospace systems engineer, and an electronics technician. The women share their experiences and talk about the benefits and challenges associated with working in their jobs. A User's Guide designed to facilitate discussion is also available.

Radio-Québec, Abitibi-Témiscamingue.
Femmes au supermarché de l'emploi. Québec: Radio-Québec, 1986. 26 min. Profiles women working in mining, forestry and agriculture.

Radio-Québec.
Femmes de métiers - Femme au travail. Québec: Radio-Québec, 1987. 26 min. Presents women working in occupations tradtionally reserved for men. From a chief engineer in forestry to a landscape architect, the women recount how they came to choose their work and the benefits they receive from it.

Vidéo Femmes.
Du rêve à la réalité. Québec: Viédo Femmes, 1982. 27 min. Ten women working in a range of non-traditional occupations talk about their experiences, providing role models for those who want to realise their dreams in similar occupations.

Women in Trades and Technology.
Let's Go To the Shop. Winlaw, BC: Kootenay Women In Trades and Technology, 1989. 50 min. 1/2" Produced by Joan Webb and Gillian Browning. This video provides an overview of the issues addressed at the National Women in Trades and Technology Conference, 1988, and includes additional footage of women working in the field of trades and technology.

Women Inventors Project.
What If?/Et Si...des inventrices et entrepreneuses. Etobicoke, Ontario: Women Inventors Project. 16 min. This unique video features interviews with seven successful inventors and entrepreneurs. From farmer to actress to engineer, the women profiled are a diverse and dynamic group. Their inventions - computer aids for the disabled, a novel mirror, award-winning furniture and a new yeast strain - are equally varied and creative. Up-beat, informative and professional, the video is an educational tool useful for teaching about innovation, entrepreneurship and practical applications of science and technology. Suitable for Grades 7 to University.

Women Inventors Project.
Women Inventors. Etobicoke, Ontario: Women Inventors Project. 15 min. Suitable for students in Grades 6 to 12, this video was filmed at a national workshop for women inventors in Waterloo, Ontario, and features interviews with women inventors of all ages (8 to 60+), a display of women's inventions, an examination of how new ideas are brought to the market, a discussion of the barriers for women inventors, and strategies for change. It fits well with a variety of curricula, including science and technology.

APPENDIX C

Distributors

Répertoire des productions audio-visuelles sur la condition féminine
1255, Place Philippe
bureau 708
Montréal (Québec)
H3B 3G1
1-800-463-2851

Répertoire Vidéo Femmes
56, rue Saint-Pierre, bureau 203
Québec (Québec)
G1K 4A1
418-692-3090

Journals and Newsletters

Arithmetic Teacher
Official Journal of the National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

Association for Women in Computing Newsletter
407 Hillmoor Drive
Silverspring, Maryland 20901

Association for Women in Mathematics
Newsletter
Box 178 Wellesley College
Wellesley, Maryland 02181

Broadcast
The Newsletter of the Math/Science Network
Resource Center
2727 College Avenue
Berkeley, California 94705

Canadian Journal of Mathematics and Canadian Mathematical Bulletin
Canadian Mathematical Society/Société Mathématique du Canada
577 King Edward
Suite 108
Ottawa, Ontario K1N 6N5

Classroom Computer Learning
Pitman Learning, Inc.
19 Davis Drive
Belmont, California 94002

Computers in Education
Canada's Computing Magazine for Educators
1300 Don Mills Road
North York, Ontario
M3B 3M8

The Computing Teacher
University of Oregon
1787 Agate St.
Eugene, Oregon 97403

APPENDIX D

Crucible
Science Teachers' Association of Ontario
Box 2699 -Station B
Richmond Hill, Ontario L4E 1A7

Education Forum
The Magazine for Secondary School Professionals
60 Mobile Drive
Toronto, Ontario M4A 2P3

Entre Nous
Association des enseignantes et des enseignants franco-ontariens
681 Chemin Belfast
Ottawa, Ontario K1G 024

EUREKA
The Teachers' Network Newsletter
Brooklyn College of the City
University of New York
Bedford Avenue and Avenue H
Brooklyn, New York 11210

Federation of Women Teachers' Association of Ontario Newsletter
1260 Bay Street
Toronto, Ontario M5R 2B8

Feminist Teacher
Feminist Teacher Editorial Collective
Ballantine 442
Indiana University
Bloomington, Indiana 47405

Info créfo Bulletin d'information du Centre de recherches en éducation franco-ontarienne
CREFO IEPO/OISE
252, rue Bloor ouest
Bureau 6-210
Toronto, Ontario M55 1V6

International Organisation of Women and Mathematics Education/Le Mouvement International pour les Femmes et l'Enseignement de laMathématique (MOIFEM/IOWME)
IOWME/OISE
Department of MECA
Ontario Institute for Studies in Education
252 Bloor Street West
Toronto, Ontario M5S 1V6

The Journal for Research in Mathematics Education
National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

Mathematics Teacher
1906 Association Drive
Reston, Virginia 22091

Mathematics Teaching
Association of Teachers of Mathematics
7 Shaftesbury
Derby, England
United Kingdom DE3 8YB

McClintock Memos
Australian Science Educators
The McClintock Collective
Hawthorn Professional Development Centre
11 Paterson St.
Hawthorn, Victoria 3122
Australia
$18.00 Canadian/year

News: The Magazine for Elementary School Educators
Ontario Public School Teachers' Federation
1260 Bay Street
Toronto, Ontario M5R 2B7

Ontario Mathematics Gazette
The Ontario Association for Mathematics Education/
Association ontarienne pour l'enseignement des mathématiques
Secretary-Treasurer
Don and Carol Attridge, O.A.M.E.
1 Southdale Drive
Markham, Ontario L3P 1J6

Our Schools, Our Selves. A Magazine for Canadian Education Activists
OS/OS
1698 Gerrard St. East
Toronto, Ontario M4L 2B2

APPENDIX D

Output
ECOO's Newsletter
Educational Computing Organization of Ontario/Organisation ontarienne pour la cybernétique en éducation
P.O. Box 2306
Cambridge, Ontario N3C 3P8

School Science and Mathematics
Official Journal of the School Science and Mathematics Association, Inc.
126 Life Science Building
Bowling Green State University
Bowling Green, Ohio 43403-0256

Science and Children: The Journal Devoted to Preschool through Middle School Science Teaching
National Science Teachers Association
1742 Connecticut Avenue N.W.
Washington, D.C. 20009

Skillsletter
Communications and Marketing
Ministry of Skills Development
11th Floor
101 Bloor Street West
Toronto, Ontario M5S 1P7

WITT National Network Newsletter
Women in Trades, Technology, Operations & Blue Collar Work
R.R. 1
Winlaw, British Columbia V0G 2J0
604-226-7624

Women's Education des femmes
Canadian Congress for Learning Opportunities for Women/Congrès canadien pour la promotion des études chez la femme (CCLOW/CCPEF)
47 Main Street
Toronto, Ontario M4E 2V6

Women in Instructional Technology
New York Institute of Technology
French Chateau, Room 101
Old Westbury, New York 11568

Associations

Association canadienne-française pour l'avancement des sciences
2730, chemin de la Côte Ste-Catharine
Montréal, Québec H3T 1B7
514-342-1411

Canadian Association of Women in Science
P.O. Box 6054, Stn A
Toronto, Ontario M5W 1P5

Canadian Research Institute for the Advancement of Women/Institut canadien de recherches sur les femmes (CRIAW/ICREF)
Suite 408, 151 Slater
Ottawa, Ontario K1P 5H3
613-563-0681

Canadian Teachers' Federation/Fédération Canadienne des enseignantes et des enseignants
110 Argyle Ave.
Ottawa, Ontario K2P 1B4
613-232-1505

Ontario Teachers' Federation/La Fédération des enseignantes et des enseignants de l'Ontario
1260 Bay Street
Toronto, Ontario M5R 2B5
416-966-3424

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91 Rue St-Jean
Rm. 300
Longueuil, Quebec J4H 2W8
514-646-1030

Sociéte pour les Canadiennes en science et technologie/Society for Canadian Women in Science and Technology (SCWIST)
P.O. Box 2184
Vancouver, British Columbia V6B 3V7

APPENDIX E

Women and Mathematics Committee of the Ontario Association for Mathematics Education
c/o Lorna Wiggan
York University Faculty of Education
4700 Keele Street
Downsview, Ontario M3J 1P3
416-736-5018

Women in Scholarship, Engineering, Science and Technology (WISEST)
c/o Dr. M.A. Armour
Dept. of Chemistry
University of Alberta
Edmonton, Alberta T6G 2G2

Women in Science and Engineering/Femmes en science et en génie (WISE/FSG)
P.O. Box 6067, Station A
Toronto, Ontario M5W 1P5

Women in Trades and Technology (WITT)
Seneca College, Oakville Campus
216 Lakeshore East
Oakville, Ontario L6J 1H8

Women Inventors Project
1 Greensboro Drive, Suite 302
Etobicoke, Ontario M9W 1C8
416-243-0668